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FLIGHT

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Corporation Co-operation?

THAT respected leader of Air France, M. Max Hymans, has been writing in the British Press about Air Union—the new European airline alliance of France, Germany, Italy and Belgium. His words are reported on pages 310 and 311 of this issue. They are, incidentally, worth reading for their literary as well as for their intrinsic value.

He speaks for a powerful trend in today's world of air transport—co-operation. Air Union, and the S.A.S.-Swissair equipment-merger that preceded it, have undoubtedly provided the stimulus for pan-Commonwealth airline co-operation that is now emerging from the what-a-splendid-idea stage. It is important for the future of British air transport that this should be so. It is just as important that there should be more co-operation between B.O.A.C. and B.E.A.

Air Union has miraculously swept aside differences of nationality, language, currency and ownership in order to cut costs and compete through co-operation. Meanwhile, our two State airlines, who have no such differences (and whose main bases are within a few minutes' walk of each other), operate no joint technical or operational services whatsoever. This is the only conclusion that can be drawn from the joint B.E.A.-B.O.A.C. memorandum that was published as an appendix to the recent Select Committee report on the two Corporations. Co-ordination of effort even in the commercial field is limited virtually to ticket-selling abroad, with some occasional joint advertising. Perhaps the time is ripe for airline co-operation to begin at home.

Sowing at Cranfield

WHILE the effulgent aeronautical symposia and the mystical astronautical colloquia have been blossoming in the exotic places of the earth (where formerly mere conventions bloomed), a new, and in many ways more desirable, seed has been planted in Buckinghamshire, England. That, at least, is what occurred to us on preparing reports (last week and this) of the International Conference called to discuss technical problems of agricultural aviation. For here, at Cranfield, were assembled people charged with bringing forth a greater abundance from the soil. Some were there to sell aircraft—America's Piper and Brantly, Holland's Kolibrie and the Czech L.60—as a means of achieving this end; others to sell their services or techniques. But *Flight's* representative reports that the conference was remarkable more for its collegiate atmosphere of scientific inquiry than as a platform for salesmen; and the demonstrations of aircraft provided a sounding-point for new ideas in agricultural application rather than a manifestation of something already achieved. The ideal in airborne farming vehicles has yet to be realized.

Though financial and material hazards will continue to beset development in these islands, a spokesman for Crop Culture (Aerial) Ltd. has said that given a period for development and freedom to establish a realistic price structure, based on the problems and hazards which nature and the British landscape have jointly contrived, the aerial operator may well find a place in the agricultural scene. But these are domestic matters; whereas over great areas of the globe an ever-increasing population is clamant for more and more food. If this clamour is to be satisfied (we echo Sir Miles Thomas), then agricultural aviation must create a good and true image of its activities in the public understanding. With the Cranfield conference Britain has taken an international lead, in doctrine if not yet in practice.

FROM ALL QUARTERS

PODDED PAYLOAD: Sikorsky's S-60, derived from the familiar S-56, is here seen at Ft. Belvoir, Va., carrying 20 U.S. Army troops in its recently added "people pod." It may be compared with Westland's pod Westminster (September 4, p. 136 and September 18, p. 246)

Folland Join Hawker Siddeley

TAKE-OVER of Folland Aircraft Ltd. by the Hawker Siddeley Group became effective last week when Philip Hill, Higginson and Co. Ltd. announced that their offer to purchase for cash at 10s 6d a share all the issued share capital of Folland Aircraft (*Flight*, August 21) had been accepted by holders of 1,408,604 shares, equivalent to 90.87 per cent of the total.

Sir Roy Dobson, managing director of the Hawker Siddeley Group, commented that the move was "in the best interests" of all concerned; there was a natural affinity, he said, between Folland and Hawker in the field of fighter aircraft.

John Harvey Heyworth

WE record with regret the death, on September 21 at the age of 49, of W/C. John Harvey Heyworth who, as a Rolls-Royce test pilot, made many early flights with jet aircraft. He joined Rolls-Royce in 1936, flew with the R.A.F. throughout the Battle of Britain (commanding No. 79 Squadron), then returned to Rolls-Royce during the latter part of the war. He became chief test pilot in 1951, but retired from this post in 1954, after a flying accident. He then joined the Rolls-Royce export sales department.

In 1946 Heyworth was awarded the Air Force Cross and in 1954 the Derry and Richards Memorial Medal for experimental flying in the field of turbojet development. He leaves a widow and two daughters, and his younger brother, A. J. Heyworth, is the present chief test pilot of Rolls-Royce Ltd.

JP-6 for the B-70

LIKE the B-58, the B-70 Valkyrie intercontinental bomber, being developed for Strategic Air Command under the management of North American Aviation Inc., is the subject of possible retrenchment. Straws in the B-70 wind are worth watching, since they give a pointer to fundamental decisions which will affect the evolution of supersonic transports for years to come. It is particularly worth noting that high-energy fuels for gas turbines have been eliminated.

During the past few weeks the U.S. Department of Defense, and the U.S. Air Force and Navy, have jointly concluded that technological developments have tended to by-pass the range of high-energy fuels which have in recent years been under intensive development for combat use, particularly by jet aircraft. The most important of these fuels were based on boron. The decision to cease boron work will be a severe blow to a number of chemical firms, particularly Callery Chemical Corp., who were to have operated a large plant for the U.S.N., and Olin Mathieson Chemical Corp., who had been charged with the production of boron fuel at a $45m plant owned by the U.S.A.F. Research into high-energy gas-turbine fuels will continue, and Stauffer Chemical Co. have announced that their contracts are unaffected.

Chief users of high-energy fuel in the immediate future would have been the U.S.A.F. North American B-70 Valkyrie and F-108 Rapier. Both of these aircraft would eventually have been powered by General Electric J93-5 turbojets burning boron fuel in the afterburner. The -5 engine has been cancelled after about $10m had been spent on its development. In its place a speed-up has been ordered on the J93-3, which will be used for all the first B-70s and F-108s, burning conventional hydrocarbon fuel throughout. At present it appears likely that the fuel employed will be the new JP-6, which has a higher heat content and specific gravity than the fuels commonly used. It has been reported by *Aviation Daily* that the U.S.A.F. will next month start a flight-evaluation programme on JP-6, using a J79-powered F-104.

Earlier this month it was revealed that, in order to "assure manœuvrability and stability at high speeds," the B-70's wing tips will be arranged to fold downward in flight. Design and production of the wing was assigned by N.A.A. to Boeing at Seattle, and Boeing have in turn sub-contracted the folding-tip mechanism to Curtiss-Wright. Boeing have also announced details of a super hot-draw furnace and three deep freeze chambers which will successively heat the B-70 wing panels to 1,750 deg F, cool them to room temperature, and freeze them to minus 100 deg F before reheating to nearly 1,000 deg. This remarkable temperature cycle is required in the brazing of the stainless-steel honeycomb sandwich panels (*Flight*, April 10).

Elliotts' New Sailplane

AN entirely new sailplane, with a 15-metre wing span, is being designed by Elliotts of Newbury. If design and development work go well a prototype should be ready for the 1960 World Gliding Championships. If so, David Ince will fly it. The price of the production machines should not exceed £1,000 (plus instruments) and the type should be available at the end of 1960. The makers expect that "it will be second to none in the world."

Elliotts remark that no claims will be advanced or further details published until the first prototype has flown; and they would appreciate it if those interested would refrain from requesting further information until that time.

Discussing Workers' Futures

DIVERSIFICATION and redundancy in the aircraft industry were two matters discussed by the Minister of Supply, Mr. Aubrey Jones, with a deputation from the Confederation of Shipbuilding and Engineering Unions on September 15. The C.S.E.U. representatives urged that an Aircraft Advisory Council, with employer and trade union members, should be set up; but the Minister said that the need for diversification, following "the inevitable contraction" of the industry, made it desirable to tighten rather than loosen ties with engineering as a whole. He was therefore reluctant to set up an advisory body separate from the Engineering Advisory Council. On redundancy, Mr. Jones agreed to encourage firms to give workers' representatives longer notice of cuts and a clearer outline of employment prospects.

ORNITHOPTER: Russian designers have long devoted much time to flapping-wing machines; here Dmitry Ilyin is seated in his 3 h.p. model, which in theory can fly him at 62 m.p.h. Free flight has yet to take place

VISITING AVRO are, from left to right, Air Marshal S. C. Elworthy, D.C.A.S.-designate, who witnessed Vulcan B.2 and Blue Steel production and is seen with Mr. J. A. R. Kay, managing director, and Mr. O. J. Hawkins, test pilot; and Air Marshal S. Mukerjee, Chief of Air Staff of the Indian Air Force (centre of right-hand group), with Mr. C. E. Fielding, works director (left), and Mr. W. Maiden, works superintendent

Shop stewards from Short Brothers travelled to London to lobby the meeting, during which the Minister (according to Mr. Frank Foulkes, the C.S.E.U. president, who led the deputation) said he would "increase his encouragement to Shorts for greater diversification and consultation." Mr. Jones also said that there should be between 200 and 350 production workers employed on the Britannic order by the end of the year, and this figure would rise to 3,500 within two years.

Glider Aerobatic Championship

THIS year's national glider aerobatic champion is F/L. B. B. Sharman of the R.A.F. Gliding and Soaring Association, who in a red-and-cream Olympia 419 won the third annual contest at Dunstable last Sunday. He scored 247 points, a clear lead of nine over his nearest rival, P. C. Dirs of the London Gliding Club, at whose site the competition was held. F/L. Sharman also gained the spot-landing prize (sharing this with F/L. L. Kurylowicz of the Chiltern G.C. in a 3ft "tie"); and Dirs, who was one of the youngest contestants, received an additional prize given to the new entrant who had done best in the competition. Third place went to Lt-Cdr. H. R. Dimock of the Portsmouth Naval G.C. (232 pts); and close behind him, with 230, was another R.A.F. G.S.A. entrant, F/L. D. S. Bridson.

Each competitor had to do four set manœuvres—two loops and two chandelles—after being released at 2,500ft, then contribute a free series of aerobatics. F/L. Sharman, who as a former holder of the C.F.S. trophy is an experienced aerobatic pilot, had the advantage of flying a glider stressed for inverted flight and made impressive use of this capability—as did F/L. Bridson when he later flew the same Olympia 419. Peter Dirs gave a neatly executed demonstration of skilful spinning and stalling and Lt-Cdr. Dimock used aileron turns on top of a loop to form a four-leaf clover pattern.

The premier award, the Jack Hanks Trophy, was this year supplemented by a prize of £50—divided between the three best pilots—donated by Mr. J. B. Emmott of Kenilworth, who made the presentations. The amounts of £25, £15 and £10 are to be spent on gliding equipment and instruments. This generous gesture marked a happy occasion enjoyed by all concerned.

Canadian 500 h.p. Turbine

DEPICTED in an accompanying photograph, the PT6 is the first Canadian aircraft shaft-turbine engine. Designed by Canadian Pratt & Whitney Aircraft (who also shared in the initial design of the familiar JT12 turbojet), the PT6 has been planned as a basic unit which may be adapted for use in aeroplanes, helicopters and VTOL devices.

As the illustration suggests, concentric shafting has been avoided by the back-to-front layout, air being taken in around the rear and the jet efflux issuing from two ducts immediately behind the reduction gearbox. No design details have been divulged but the compressor is almost certainly axial/centrifugal and the combustion chamber is likely to be an annular unit with 14 burners. An integral oil tank serves the powerplant and the propeller, and the complete engine can operate continuously at any angle from 45 deg down to 110 deg up. The design has been biased in favour of easy maintenance "with a minimum of servicing between overhaul periods of 1,000 hours."

Studies began last October; detail design was put in hand early this year, development testing is now taking place at Montreal and prototype flight engines are promised in 1961. Both versions have a maximum rating of 500 s.h.p. with a guaranteed s.f.c. of 0.69. The turboshaft engine has a maximum output r.p.m. of 6,000 and weighs 225 lb, while the turboprop drives at 2,400 propeller r.p.m. and weighs 250 lb.

IN BRIEF

Last week Scott Crossfield flew the North American X-15 under limited rocket power.

The Ministry of Supply has announced that Mr. A. N. Christmas, a superintendent at the Armament Research and Development Establishment, Fort Halstead, Kent, since 1954, has been appointed Director of Guided Weapons Research and Development (Techniques).

Third Air Force headquarters announced on September 8 that contracts worth £2,043,725, for the supply of 79,500,000 gallons of jet fuel for U.S.A.F. aircraft in Britain, had been awarded to Esso Petroleum Co. Ltd. and Asiatic Petroleum Co. Ltd. The fuel will be supplied direct from British refineries to U.S.A.F. units.

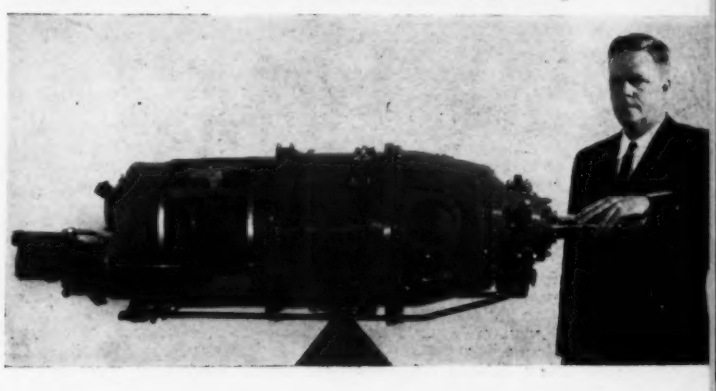
Mr. D. McN. Greig, O.B.E., who carried out some pioneer newspaper-delivery flights from London to various parts of Britain and the Continent shortly after the First World War (in which he served as a major in the R.F.C.), has died at the age of 62. He was joint free-trade manager of Courage and Barclay Breweries.

The first of thirteen Canberra B(I).12s ordered for the R.N.Z.A.F. was formally handed over at the English Electric airfield at Warton, near Preston, on September 17. Mr. G. R. Laking, New Zealand Acting High Commissioner in the U.K., received the aircraft log book from Lord Caldecote, the company's deputy managing director.

Boeing have been given the go-ahead on the new B-52H model of the Stratofortress. A change to the Pratt & Whitney JT3D turbofan engine, with a dry rating of 17,000 lb, has allowed the gross weight to rise substantially and the range to be extended well beyond the "more than 9,000 miles" limit of the B-52G. From the outset the H will carry a pair of Hound Dogs. The first of the new machines is scheduled for completion early in 1961.

The developed version of the Italian Falco is now being produced at Trento by Aeromere at the rate of about three aircraft a month. Ex-works price is just over £4,000 for a standard aircraft with generator, starter, fixed pitch propeller and a Lycoming O-320 giving 150 h.p. The type has now received a full British C. of A. for normal and aerobatic flying and the demonstrator, with an Aeromatic variable-pitch propeller, is kept at Denham by the British agent, Mr. C. H. Cosmelli of 12 Chalkhill Road, Wembley Park, Middlesex. The Falco can cruise at 186 m.p.h. and has a top speed of 224 m.p.h.

500 H.P. PACKAGE: Described in an accompanying news item, Canadian Pratt & Whitney's PT6 free-turbine engine is seen here in its turboprop form. With it is Thor E. Stephenson, the company president



Airborne Farming Goes To College

EDUCATIONAL CRANFIELD DISCUSSIONS

LORD NETHERTHORPE, who opened last week's International Agricultural Aviation Conference at the College of Aeronautics, Cranfield, by reading a message of welcome from the Duke of Edinburgh, described it as "an animated affair". Certainly the delegates welcomed this first-ever opportunity of discussing, in and out of session, this most-mechanized branch of land husbandry, and the discussion period on more than one paper handsomely overran its allotted time.

All in all, the papers presented appeared to cover the field (to use the conference idiom) fairly adequately, although it was surprising that among the British contributions not one dealt exclusively with application by helicopters, a type of agricultural flying in which Great Britain has established a lead. But many of the gaps that were left by the prepared papers were made up in the ensuing discussions.

Topics were almost equally divided between agrarian or chemical matters and those pertaining to the design and operation of agricultural aircraft and the organization of aerial-farming units; it being generally assumed that the present system whereby the farmer contracts to an operator—often through an agent—is the most satisfactory business arrangement. No case is being put forward for European farmers to operate aircraft for spraying and spreading duties themselves; the season when aerial application is required is far too short to make such a proposition economical. In any case quite a substantial supporting force is necessary for efficient operation, and a very high standard of flying skill is required.

It is implicit in the low-level nature of agricultural flying that quite a high degree of risk is involved. In his paper on *Ground Organization—the Pilot's View*, Capt. R. Bradbury, senior pilot of Fison-Airwork, estimated the annual world average figures of serious crop-flying accidents as 40 per cent of the total number of aircraft in agricultural operation. Of these, only 4 to 6 per cent were the results of mechanical failures. Another analysis, given by H. G. Winton in his paper on *International Airworthiness Requirements for Agricultural Aircraft*, quoted accident figures for the U.S.A. between 1954 and 1956 as one per 2,300 hr or 27,840 flights; for Australia between 1953 and 1957 as one per 920 hr or 11,040 flights; and for New Zealand (1958 only) as one per 1,580 hr or 18,300 flights. The danger of a fatal accident in an agricultural aircraft was about 600 times greater than the risk of a fatal accident caused by structural collapse of an aircraft used for normal purposes.

It is against this background that the safety of agricultural-aviation equipment must be considered—particularly in respect of structural protection for the pilot—as well as from the aspects of adequate performance, convenient layout, avoidance of chemical corrosion, and—because the number of flights completed per hour must mitigate against long airframe lives being achieved—structural fatigue. Again quoting from Mr. Winton's paper, the anticipated average safe life for a hypothetical crop-flying aircraft with an average operational flight-time of five minutes is only 1,250 hr or 15,000 flights. The same aircraft flying 2 hr sorties at 2,000ft and 120 m.p.h. would be good for 14,000 hr—an adequate reserve for a light aircraft.

So far no complete set of British safety requirements for agricultural aircraft exists, and Mr. Winton's paper set out to compare the Australian, New Zealand, United States and British airworthiness standards as they affect small, fixed-wing aircraft.

As spraying and dusting operations took place at fairly slow speeds, he pointed out, there was some case for overloading within quite wide limits. If the speed did not exceed $V_s\sqrt{n}$ (where V_s was stalling speed and n the original value of the positive manœuvring factor) the aircraft would stall before the wings could be loaded beyond their limit. In practice, Mr. Winton suggested, this limiting speed could probably safely be fixed at $0.9V_s\sqrt{n}$ with the aircraft at an overload weight.

Rather similar arguments applied to the gust case. Where the stalling speed was about 50 m.p.h. the 66ft/sec gust rarely produced a wing-loading greater than that specified in the manœuvring case; and if gusts of such intensity were prevalent, it would be a foregone conclusion that operation was impossible.

So far as performance was concerned, agricultural aircraft should have a minimum rate of climb at least equal to, and perhaps higher than, that of similar aircraft used for normal purposes. In New Zealand the differential already existed; *en route* rate of climb for agricultural aircraft must be $6V_{s1}$ft/min (V_{s1} represented stalling speed in m.p.h.) and if it was required to operate near populated areas the baulked landing rate of climb must be the greater of 200ft/min or $0.07V^2_{s0}$ft/min (V_{s0} was stalling speed flaps set for landing). For aircraft designed for agricultural purposes from the outset, U.S. requirements stipulated the greater of $8V_{s1}$ or 300ft/min, and draft British requirements called for a gradient of 4 per cent or 300ft/min, whichever was the steeper.

The widest experience of aircraft operation and chemical manufacture are conjoined in the person of Sir Miles Thomas, seen reading the opening paper. With him is Mr. R. C. V. Dodd, the conference organizer

Typical of the consideration that was being given to agricultural aircraft in the British airworthiness code was the proposal to include in the flight manual take-off distances from grass-covered surfaces as well as from hard runways, and if possible supplementary information would be given as to the effect of wet grass.

Criticism of the flight manual as too bulky a document to be carried on the average small aircraft led to a suggestion by Mr. Winton that a series of cards should be prepared giving the maximum weight at which take-off could be made in the prevailing ambient temperature and available distance. These would be in non-graphical form and could be stored in the cockpit.

In setting out a paper on *Distribution Equipment Design Notes*, R. F. Hill concluded that ideally, for a fixed-wing aircraft incorporating the particular requirements he outlined for low-level spray work, special designs of aircraft were required. The present trends in aircraft design were towards higher speeds at the expense of low wing-loadings, so that the future choice of aircraft was likely to be more restricted than it was at present.

In an operation which was admittedly hazardous by normal standards, said Mr. Hill, it was essential that the safety of the pilot be placed before any other consideration, and "this is more difficult than one would expect when installing a spray or dusting system in an aircraft not designed for agricultural work." Among other points the author made were that operating controls should be placed where they could be reached without the pilot having to twist or stretch; that handles should have distinctively fashioned ends; and that pressure gauges should be positioned so that there was no risk of confusing them with engine instruments. It was also as well to check, in a modified aircraft, that there was no possibility of the wrong control being operated accidentally.

Insecticide-tank design—the *raison d'etre* for the agricultural aircraft—must be settled and stowage decided at an early stage. The volume should be sufficient to allow for foaming and to prevent leakage during manœuvres, and the base must be shaped so that it would drain completely. Generous filler-necks were important, and provision must be made for draining spilt liquid. So far, there had been some reluctance to use pressure refuelling systems, but the use of the more toxic chemicals that were now being proposed might make this essential. Filters must be large enough to handle the liquid at the expected rate of flow even when partially clogged, and hand-holes were required for tank inspection; preferably such inspection should be possible without removing the tank from the aircraft.

An interesting sidelight on tank design, continued Mr. Hill, was a study of the different materials that could be used in its construction. Tinned steel folded and sweated, welded magnesium or stainless steel, and riveted aluminium sheet; all these had been used, while polyester-plastic reinforced with glass-fibre shared with stainless steel the advantage that it did not need additional protection. "Rubber-bag" plastic tanks were another possibility and might weigh only 2 lb per 100 gal capacity.

Comparing the various materials on a basis of weight and cost, Mr. Hill concluded that, as container weight was such a small proportion of the weight of an installed loaded tank, fabrication cost might decide the choice—present-day prices for aluminium were 4s per lb, for polythene 10s per lb and for stainless steel 18s per lb. [Reference to tank installations was also made in the paper on *Airworthiness Requirements*. The most stringent regulations were those in force in New Zealand, which required that for a hop-

per placed behind the crew accelerations of 12g forward and 2.5g sideways must be considered. Provided reliance could be placed on the attachments "there would appear to be nothing to choose between siting the hopper either behind or in front of the pilot."]

Should spray booms be streamlined? Yes, said Mr. Hill, for any speed over 70 m.p.h. there was a worthwhile reduction in parasite drag. For example, a round boom 10ft long at 80 m.p.h. had a drag of 12.5 lb and a streamline boom with a fineness ratio of 3.5 had a drag of only 0.68 lb—but to obtain full advantage of this the boom ends should be carefully faired.

Finally, the paper discussed atomizers, such as the gas-burner type, hollow-cone nozzles and swirl plates, and the disc, cage and brush types of rotary atomizer. A new device was a French invention which enabled droplet size to be varied independently of output by altering the quantity of air that mixed with the spray liquid when it left the nozzle. Another was the American Swathmaster, a hollow stainless-steel aerofoil pierced by a large number of holes; fluid was fed into it through an adjustable trap.

"Flight" photograph

Controlled application and quick turn-round reach their present zenith with the helicopter. Here the Djinn demonstrates the technique

One especially pressing problem in agricultural aircraft design is that of corrosion. A paper on this subject, *Corrosion by Agricultural Chemicals of Airframes and Spraying Equipment*, was delivered by F. C. Porter, a metallurgist with the Aluminium Development Association.

Corrosion in agricultural aircraft, said Mr. Porter, started with water from rain, from spray solutions, or from water absorbed from the atmosphere. Good design of both aircraft and spraying equipment could help to reduce corrosion risks; in particular, the elimination of crevices and inaccessible recesses and careful avoidance of contact between dissimilar metals. One of the most effective ways of cleaning an aircraft was to wash it down with water, so good design demanded drainage holes, sections that were convex upwards, butt joints rather than lap joints, and liberal use of jointing compounds.

Discussing the effects of chemicals on various materials, Mr. Porter noted that the unclad high-strength aluminium alloys had rather low corrosion-resistance compared with aluminium or clad sheet; and anodizing was not of much value, as the anodic metal dissolved in some acid or alkaline conditions. Monel metal and stainless steel were excellent but expensive; mild steel was satisfactory if both cadmium-plated and painted (zinc-plated fasteners in aluminium panels tended to corrode sacrificially); but copper-based materials had only limited use. Resin-bonded glass-fibre had excellent short-term corrosion resistance.

A paper on *Flight Techniques for Fixed Wing Aeroplanes in Agricultural Aviation*, read by L. R. Lucassen, flight test engineer at the National Aeronautical Research Institute in Amsterdam, was unusual in that it discussed quite basic flying techniques, many of which, of course, were later demonstrated during the flying which ended the conference. Although there was little here with which agricultural pilots of any experience would not be familiar, the paper may have served its purpose in apprising farmers and pilots of such necessary techniques as short take-offs, down-wind landings, keeping the c.g. within the limits of trim, and the mental discipline necessary in turning into and out of wind—the majority of agricultural flying accidents stemming from airmanship causes are still the result of losing flying speed. Two opinions expressed by Mr. Lucassen are worthy of record: in making a short take-off, it is not worthwhile lowering flap just before flying speed is attained. The reduction in air resistance at lower speeds is insignificant, and the action distracts the pilot at a critical phase. Also, a stall-warning indicator is most useful, and should be set to function two knots above stalling speed in level flight with the throttle closed.

Referred to in the text is the Swathmaster dispenser unit, here being used by the Transland Ag-2, one of a number of new U.S. agricultural aircraft. The swath width achieved is claimed to be "up to 100ft"

A further paper on piloting, *Agricultural Aviation in England: Low Flying Techniques and Pilot Safety*, was presented by the very experienced chief pilot of Crop Culture (Aerial), J. M. McMahon. Speaking of the design of aircraft for the job, he listed the following features as pre-requisites: (i) crash-worthiness; (ii) manœuvrability and viceless stall; (iii) a reserve of power; (iv) short landing ability; (v) good visibility; (vi) a simple and comfortable cockpit; (vii) load over the c.g.; (viii) foolproof, quick jettisoning. Many operators, he said, were still searching for an aircraft which embodied these features.

Agricultural flying, Mr. McMahon emphasized, was a technique that had to be learned, and it required great enthusiasm. Few pilots who entered agriculture just for the sake of accumulating flying hours could expect to pass a final interview. Familiarization and learning to relax at the controls alone seldom occupied less than five hours, and full training—even of an experienced pilot—took 20-25 hours. This might be thought expensive but it was cheaper than crashed aircraft.

The latter half of Mr. McMahon's paper was a series of commentaries on practical aspects of agricultural flying. Among his many recommendations were that an investigation should be held into the cause of a shortage of British licensed engineers "with a solid background of engineering" and suitable for agricultural field service; the law should be amended to allow pilots to swing their own propellers when alone; performance charts are almost useless, and training for visual assessment of take-off distance should be encouraged; jettisoning gear should be compulsory on all agricultural aircraft; and, finally, the U.S. practise of placing *no load or operational restrictions* on agricultural aircraft should be adopted. Conditions varied widely, but no operator could afford to overload to a point where accidents resulted. The best safeguard was to have approved operators, and a close watch should be kept on their maintenance and training.

The last two papers presented came under the heading of *Ground Organization*. The first, *The Pilot's View*, was given by Capt. R. Bradbury, who probably painted as good a picture of life in the field as has yet been given. In discussing operational *desiderata* he emphasized that the crop-campaign headquarters should be close to the area of operation; that care should be taken to provide fast, easy refilling; that human markers in the field should be the "masters of ceremonies" of the operation; and that identical maps of the correct scale should be used by both ground

The L-60 Brigadyr demonstrates that it is an excellent sprayer

"Flight" photographs

Auster's Workmaster—a British design praised for lively performance

Re-filling the Hiller UH 12C in 60 seconds is now commonplace

Airborne Farming Goes To College . . .

staff and pilot. But most of all Capt. Bradbury accentuated the human qualities that were required of the people employed in the field—pilots who could work with a team "despite frayed tempers and fatigue"; engineers who were prepared to undertake refuelling, assist the tanker crews, check chemical and fuel consumptions and arrange meals and night stops; and crews who would accept difficult working conditions with rigorous hours.

The Ground Operator's View was put by Mr. Michael Bradford, of the National Association of Corn and Agricultural Merchants. His *cri de coeur* was advance planning, and in summarizing the important basic requirements for the successful provision of aircraft for agriculture, he said that the following were the essentials: A fully briefed and efficient sales force which understood the potential, and the limitations, of agricultural aviation; efficient pilots and ground teams, including markers; an adequate reserve of aircraft; adequate facilities for a small operations room, and a reliable organizer; a first-class liaison office between pilot, ground crews and marketing organization; efficient telecommunications between landing strips, markers and operations room; an operating price which was both competitive and adequate; a fair and equitable contract between farmer, merchant and aerial contractor; adequate insurance cover; and provision of sufficient funds for advertising integrated with local sales efforts.

THE FLYING

Following the intra-mural part of the conference, a demonstration of aerial spraying had been arranged for the delegates last Friday morning, and during the afternoon the performance was repeated publicly. Undoubtedly the non-appearance of the Kolibrie H.3 helicopter from Holland and (as a result of the U.S. steel strike) the Piper Pawnee and Brantly helicopter from America, detracted from the international character of the display; the foreign representation was limited to a Djinn operated by Crop Culture (Aerial), Hiller and Bell helicopters (but including the new Hiller UH 12E shown by Helicopter Sales), a Piper PA-18-A, D.H.C. Beaver and the L-60 Brigadyr from Czechoslovakia.

By combining demonstrations of spraying and spreading techniques with displays designed to show off the aircraft, something of the routine aspect of workaday aerial application was lost; in fact, by including rapid refilling in a number of demonstrations the affair assumed the character of a Royal Tournament set-piece. Inevitably, the onus of demonstration was thrown upon the pilots, and Ranald Porteous in Workmaster or Agricola and Jim McMahon in the Crop Culture Tiger Moth both gave remarkable displays.

Perhaps the best feature of the morning was the climax it provided to the previous evening's discussion on the type of aircraft most suited to agricultural operations. When everything had been said it seemed clear enough that there was scope for both large and small aircraft—and helicopters as well—in the various tasks of aerial farming throughout the world. But it is by no means certain that the last word has yet been said on the best sort of vehicle for these operations, and a good case can certainly be made for an unmanned agricultural vehicle of a new type—a hovercraft in the broadest sense of the word. Experiments along these lines are already being conducted and it may prove significant that a Royal Aircraft Establishment observer was at Cranfield for the flying.

In what light should this conference be judged? How parochial was its purpose? Answers may perhaps have been contained in the progress report tabled by economist and ex-bush pilot Mr. D. R. Carter, who considered aviation from the viewpoint of "agricultural requirements . . . with reference to world problems."

Agricultural aviation, he commented, was akin to the blood transfusion given to a desperately sick person; it was a most suitable treatment to be *given* by governments and international bodies to those countries whose chronic poverty presents the most intractable problem to the free world. In the European Agricultural Aviation Centre there was, for the first time, a central organization which could speak with one voice, which could take concerted action and which had at its disposal information drawn from every part of the world. How, he asked, were we going to use it? Simply to increase our own riches? Or did we set out to see what could be done to help a world sickened with hunger?

* * *

Operators taking part in the demonstration were: Crop Culture (D.H.82A and Djinn); Fison-Airwork (Hiller UH 12C); Lincs Aerial Spraying (Auster J.1B); Helicopter Services (Bell 47G); Farmair (Piper PA-18-A); Airspray (Colchester) and Agricultural Aviation (D.H.82A). Manufacturers and agents demonstrating were Auster Aircraft (Agricola and Workmaster); de Havilland Aircraft of Canada (Alvis Leonides Beaver); Lancashire Aircraft (Prospector); Helicopter Sales (Hiller UH 12E); Omnipol (L-60 Brigadyr)

The ground marker acting as a "master of ceremonies" for this Thruxton Jackaroo

Crop-Culture's Tiger Moth was equipped for spraying and spreading; on the wings are the four rotary atomizers

Take-off Monitors

TAKE-OFF monitors may soon be standard equipment on airliner flight-decks and scrutiny of them among the most important of take-off procedures. This article discusses some of the variables of aircraft performance that must be taken into account in designing suitable equipment. The author is an airline captain with many years' experience on international routes and is now flying some of the newest equipment

ALTHOUGH it is widely agreed that a device is needed which will indicate the performance achieved on each jet-transport take-off (more or less suitable instruments are being produced by a number of manufacturers), little has so far been said of the problem which these instruments are trying to solve.

The performance requirements with which civil transport aeroplanes must comply are designed to ensure safety in two distinct circumstances, one in which all the engines are operating and the other in which one engine fails completely at the decision speed. It was at one time thought that taking care of the one-engine-inoperative case would ensure safety in taking off with all the engines operating. All other things being equal, take-off lengths with one engine inoperative would be longer; but all other things are not equal.

Complete engine failure at the decision point is rare; but performance with all engines operating is frequently below that achieved during certification tests in the same condition, and this is a risk to which aircraft will be exposed every day. Day-to-day variations in such influences—as, for example, assumed passenger-weights and profile-drag (which are not treated as operational parameters)—can thus lead to longer take-off lengths with all engines operating than those achieved during certification tests in which one engine is made inoperative at the most critical point.

Performance requirements are based on an accepted risk. The risk of an incident may be, for example, 1 in 100,000 take-offs. From this risk is calculated the margin to be applied to the aircraft performance. During its certification tests an aeroplane achieves a certain level of performance with all its engines operating: for example, it becomes airborne in a certain horizontal distance and reaches a height of 35ft in a certain horizontal distance. These distances are then increased by a factor dictated by the design-incident probability selected. Take-off lengths for any weight are then: one, the certificated all-engines-operating lengths multiplied by a factor (e.g., 1.18); and two, the certificated lengths with one engine made inoperative at the decision point.

Take-off will then be permitted at the weight at which the longer of these two lengths equals the take-off length available. The assumption is that only once in 100,000 times—or such other ratio as is inherent in the design-incident probability—will that take-off exceed these lengths.

Without take-off monitoring, the pilot is acting on faith from the moment he opens the throttles. He calculates the take-off weight, the flight manual implies that he is safe in taking off, and that is the end of it. Of course he can abandon the take-off if, early enough in the run, engine instruments or external references give him sufficient indication of lack of performance. But without such indication he cannot tell whether he is achieving the certificated lengths or not, or even whether he is inside the factor which has been applied. Take-off monitoring will provide the pilot with an indication of how the take-off is progressing. In other words, he will no longer be relying on faith—he will have an indication of how far his faith is justified.

First, then, take-off monitoring should provide a measure of individual aircraft performance and it should provide it at a point sufficiently early in the flight to prevent an incident.

Most of the manufacturers who are producing monitoring devices assume that the performance being measured may be allowed to fall within specified (and quite arbitrary) limits before it becomes necessary to abandon the take-off. However, the level must be directly related to the performance regulations, or the aeroplane will not comply with the safety requirements. Since each take-off at the maximum weight permitted by the runway length available complies with the all-engines-operating and the one-engine-inoperative requirements, we must examine the effect of take-off monitoring on them both.

In the all-engines-operating case the fact that take-off monitoring provides a measurement of achieved performance, might lead one to the conclusion that take-off performance, accurately monitored, could become an operational parameter, and that the margin could be removed. This might be true if the monitoring were applicable to the whole of the take-off and if the flight could safely be discontinued at any time during take-off. But take-off can be discontinued only up to the last safe stopping-point.

Moreover, the performance measured is that currently being achieved (or which has already been achieved) during the take-off run. Take-off monitors cannot forecast future performance; those which attempt to do so merely extrapolate current performance.

AN AIRLINE CAPTAIN'S APPRAISAL

Thus it is only the achieved performance up to the last safe stopping-point that is of interest to the monitors at present under consideration. This fact is of great importance, because appreciable variations in performance (90 per cent of the total take-off variation, some authorities have suggested) occur *after* the decision point. In other words, even if achieved performance is 100 per cent of the flight-manual performance up to the decision point, we are still dependent on margins, based on the analysis of the statistical variables, to ensure the required level of safety after passing the decision point—so that continued take-off with anything less than 100 per cent of the assumed performance up to the decision point may imply an unacceptable level of safety.

Further studies of the subject subsequent to the introduction of monitors may possibly enable the margin to be changed. For example, if it can be established that certain variations show up only before the decision point, then they might be related to a margin applied to one stage of the take-off, and those variations applicable to flight after the decision point applied to a second stage. Until such studies are undertaken, however, the take-off must be abandoned if achieved performance is less than 100 per cent of certificated performance.

No factors are at present applied to the one-engine-inoperative case. If an aircraft is achieving 100 per cent of its calculated performance up to the decision point and then suffers a complete failure of the most critical engine, it will comply with the one-engine-inoperative requirements. That is, the take-off length required will equal the take-off length available. If the achieved performance up to the decision point is less than 100 per cent, the aeroplane will not meet these requirements. Further, even though the performance be 100 per cent of that scheduled, an incident will result should the engine failure coincide with the presence of adverse statistical variables after the decision point. This is accepted in the design-incident probability. The assumption is that, because complete engine failure at the most critical point during take-off is rare, its incidence, coupled with adverse statistical variables, is less than the design-incident probability accepted. Thus the probability of complete failure of one engine, coupled with adverse statistical variables, is within the accepted risk.

When take-off monitoring is examined in relation to the performance regulations it may be seen that, where an aeroplane is taking off at the maximum weight permitted by the runway length available, the minimum acceptable level of performance is 100 per cent of the scheduled performance.

Although it can be foreseen that turbine-powered (particularly jet-powered) transports will be making a high proportion of take-offs at maximum runway weight, in some cases take-off weight will be restricted by obstacle-clearance, *en route* or landing requirements. And sometimes economic factors will not require the maximum permitted weight to be used.

In order to decide how to use the monitor in these circumstances it is first necessary to decide whether the extra runway length available might be used for continuing the take-off when performance was sub-standard. If excess lengths could be used in this way it would be necessary to translate additional lengths into a measurement of acceptable performance. There is reason

TAKE-OFF MONITORS . . .

to believe that the majority of variations of performance occur after the decision point, so that even with all the engines operating an allowance must be made for further deterioration after that point is reached. An allowance must also be made for complete failure of one engine at the decision point. Thus, if excess runway lengths are to be allowed to compensate for deficient performance, what must be guaranteed is that:

(1) with the speed already achieved in the distance gone;

(2) with the present acceleration; and

(3) with a further deterioration at the decision point equivalent to the longer of (a) the all-engines-operating factor and (b) complete failure of the critical engine

the aeroplane can continue the take-off safely and will satisfy the performance regulations.

The next question to be considered is: where does the pilot make his decision?

The present concept of V_1 or decision speed is that the take-off will be abandoned in the event of engine failure or an emergency up to the last point from which the aircraft can safely stop its take-off run. Deficient performance, as indicated by a take-off monitor, will in future be included in the category of "engine failure or other emergency."

V_1 speed is assumed to be reached in a scheduled distance. From this speed at this distance sufficient runway is theoretically available for a safe stop. If the aeroplane is down on performance, decision speed is reached in a greater distance than that scheduled, and insufficient length will remain for a safe stop. Speed is thus an unreliable indication of the last safe stopping-point. As distance remaining determines the last safe stopping-point, the best indication may be distance itself.

For example, for a 9,000ft runway the pilot obtains the information that, in the conditions prevailing, the distance he requires to stop the aeroplane is 3,000ft. Accordingly, he sets the monitor at 6,000ft for the decision point. During the take-off run the reading will steadily decrease until it shows zero when the last safe stopping-point is reached 6,000ft from the beginning of the take-off.

The take-off monitor gives the information that the last safe stopping-point is reached, but the monitor itself does not calculate the stopping distance; for this the device is dependent upon information supplied to it.

The present regulations on stopping distance provide for an aircraft accelerating on a dry hard surface to the point where a critical power unit fails, continuing to accelerate during recognition time to the decision point, and then coming to a complete stop using any stopway which is available.

In the case of a three- or four-engined aircraft the distance required to stop from the decision point on a dry hard surface (with one major effective means of retardation not used) is unfactored, or alternatively factored by 1.1 assuming all effective retardation devices are used. In the case of a twin-engined aircraft the distance with one major effective means of retardation not used is multiplied by a factor of 0.9, the distance achieved with the use of retardation devices being unfactored. Airline pilots are of the opinion that the stopping distance must take full account of runway surfaces, aircraft weight, pilot's reaction time, runway slope and all other conditions which affect the achieved stopping distance in day-to-day operation. One of these conditions is the speed of the aeroplane. This raises a new problem; from what speed should the stopping distance be calculated?

Where the stopping distance available is not a limiting factor, the speed used will be the rotation speed, V_R, and no problem arises. As it may be assumed that the take-off will not be discontinued after rotation has commenced, no higher speed will be attained on the ground. But when the stopping distance available is a limiting factor the decision point is moved down the runway to the last point from which the aeroplane can be safely stopped at the speed then attained. This is similar to the current situation where the decision speed is reduced below V_2, since the aeroplane can be stopped safely only from this lower decision speed. But the speed at the decision distance in an actual take-off will not be known until the aircraft reaches this distance. If the stopping distance is based on the calculated speed at this distance the information that the aeroplane can stop safely from this point may be in error. If the performance up to the decision point is better than scheduled and an emergency arises immediately before that point is reached—as shown by distance indication—the aeroplane then cannot stop safely, because it is moving at a higher speed than that from which the stopping distance has been calculated.

One solution in such cases would be to make the decision on a basis of which comes first—decision speed or decision distance. If this is accepted the concept of a V_1 speed as well as a decision distance must be retained. If the decision speed has been reached before the decision distance the pilot is committed to continue, because he cannot thereafter be guaranteed a safe stop from a higher speed. If the decision speed has not been reached by the decision distance, the pilot must then stop because performance is deficient.

Unfortunately this method is not precise since if the decision speed is reached in a shorter distance than calculated, due to better than 100 per cent performance, additional distance is available in which to stop in an emergency from a higher-than-scheduled speed. A more important objection is that the airspeed indicator does not give a reliable indication of speed at this point, and the information showing that the pilot is committed to continue the take-off may be false.

A monitor designed to determine a more precise last safe stopping-point in these circumstances would also require to be based on precise speed information. The calculated stopping-distance information supplied to a monitor might also be varied in accordance with the braking characteristics of the runway surface, thus removing the economic penalty which would be imposed if the aircraft's scheduled stopping-distance, for general use, was based on the characteristics of inferior surfaces.

In examining the information provided to the pilot at the last safe stopping-point we shall not attempt to discuss individual monitoring devices; but it is necessary broadly to review the methods of presentation in order to see how the information given is to be used by the pilot.

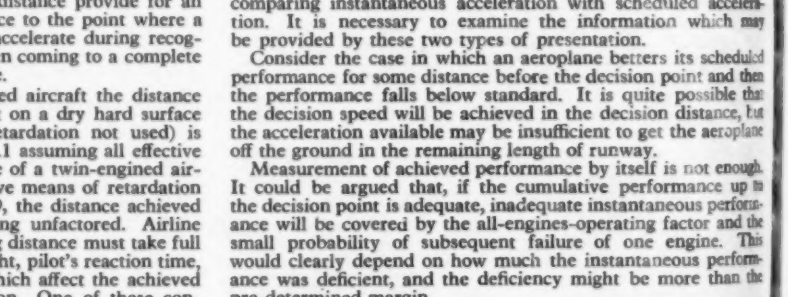
A single check at some time during the take-off run provides the simplest form of take-off monitoring. It may be a check of speed against time or distance, but it is of limited value because the airspeed indicator itself is unreliable; it might, however, be used to show up large performance-deficiencies early in the take-off run. If unreliable speed measurement can be corrected this type of monitor will give a measure of the cumulative effect of performance. Provided the regulations on stopping distance are altered, this check can be postponed to the last safe stopping-point. A different method of monitoring is provided by a device comparing instantaneous acceleration with scheduled acceleration. It is necessary to examine the information which may be provided by these two types of presentation.

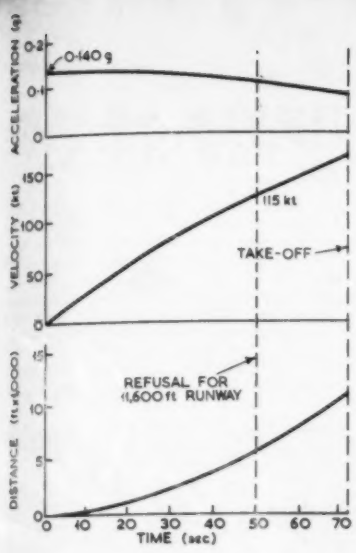
Consider the case in which an aeroplane betters its scheduled performance for some distance before the decision point and then the performance falls below standard. It is quite possible that the decision speed will be achieved in the decision distance, but the acceleration available may be insufficient to get the aeroplane off the ground in the remaining length of runway.

Measurement of achieved performance by itself is not enough. It could be argued that, if the cumulative performance up to the decision point is adequate, inadequate instantaneous performance will be covered by the all-engines-operating factor and the small probability of subsequent failure of one engine. This would clearly depend on how much the instantaneous performance was deficient, and the deficiency might be more than the pre-determined margin.

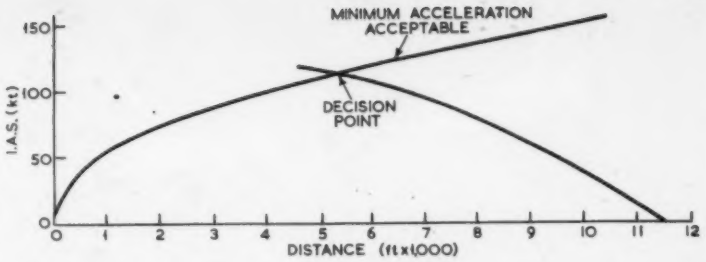
Similarly, a measurement of the instantaneous performance

This sketch shows the performance requirements for the case with one engine inoperative. The combined length of stopway and clearway must not exceed one-half the length of the runway. The proportions on either side of the end of the runway (one-third, two thirds) conform to the British code; under U.S. regulations the scheduled take-off run includes one-half of the distance from airborne to 35ft, and this fraction is also included in the PAMC prepared by the Airworthiness Committee of ICAO. Under the American code the aircraft would be at approximately 10ft at the end of the runway, instead of 3ft 4in. The requirements when all the engines are operating may be obtained by multiplying certificated run by 1.15, and distance by 1.18 (1.15 in the U.S. code)





(Left) Time history of the take-off of a heavy multi-jet aircraft



(Above) Velocity/distance profile for the take-off of a heavy multi-jet aircraft

is not enough, because fluctuations of performance may occur during the run; the pilot cannot prepare a precise mental record of the cumulative effect. If he were instructed to abort the take-off whenever acceleration was below schedule an economic penalty would be imposed.

Hence, with a critical runway, measurement of both instantaneous and cumulative performance is necessary. It is also necessary where additional runway is available, because without measurement of instantaneous performance insufficient information is available as to whether corresponding extra distance in which to get airborne will be required after the decision point.

Total take-off performance is influenced by runway surfaces, slopes, power output, aeroplane drag and wind. Should the performance measured by the monitor include or exclude wind?

For civil requirements, take-off weight is at present calculated by using 50 per cent of the forecast headwind component and 150 per cent of the forecast tailwind component.

If the monitor compares achieved with calculated ground speed it is being assumed that the wind effect is accounted for by this factoring of the forecast wind. If the effect of wind is excluded the performance of the aeroplane alone is being measured.

If the monitor compares achieved with calculated airspeed, then the wind effect is also being monitored, and including the effect of wind in this way gives a measure of the overall performance of the aircraft during the take-off. This would permit a wind effect to mask or compensate deficient aeroplane performance; but then this is the way the performance regulations are framed. However, adequate margins must be provided for variations in wind effects after the aeroplane has passed the decision point on a continued take-off. If a better-than-factored wind occurs up to the decision point, masking a performance deficiency, and then falls, safety may be jeopardized.

The masking effect of a greater wind value—somewhere between the factored and the full forecast value—could be removed by calculating take-off weight and airspeed from the full unfactored forecast wind. But in this case, although overall take-off performance is being measured, take-off would have to be abandoned whenever the wind dropped slightly below that forecast—even if the full aircraft performance was being obtained. Again, no safety margin has been provided for wind changes after the decision point. Such a method would probably lead to an economically unacceptable number of abandoned take-offs, and would remove the safety margin provided by factoring the wind.

So, even if it is agreed in principle that measurement of the overall performance of the aeroplane is required, the only safe and practical method appears to be to measure the performance of the aeroplane alone (i.e., isolated from the wind effect) by a comparison of ground speeds, and to continue to use the present method of factoring the forecast wind.

In conclusion it may be said that take-off monitors already exist. Using the devices now available in compliance with the existing performance regulations appears to be merely a question of operational planning.

S.B.A.C. ON GOVERNMENT TRANSPORT-AIRCRAFT POLICY

CONSTRUCTIVE criticism of the Government's policy on military-aircraft production *vis-à-vis* civil aircraft development was voiced last week by the Society of British Aircraft Constructors. It was contained in this statement, issued to members after a memorandum had been submitted to the Government:—

"The Council of the Society has come to a decision on certain basic points relating to Government policy, with particular reference to transport aircraft. These decisions are called for by the circumstances of special difficulty the industry is in.

"Primarily the demand for military aircraft is contracting because guided missiles are replacing aeroplanes as the major air weapons. This is happening everywhere, not only in the country, and everywhere it is causing similar problems of industrial readjustment and redundancy. The consequences cannot be escaped, in so far as they are due to . . . defence requirements.

"Although the demand for military aircraft is contracting, air transport is in its infancy as regards both volume and technological advance. Supersonic air travel is on the way, so are new devices for reducing drag and thus cheapening costs; vertical and short take-off and landing, improved engine efficiency, new metals and other materials, new equipment, instruments and controls, new and better methods of production. The difficulty is that the contraction in military aircraft requirements, which have hitherto accounted for four-fifths or so of aircraft production, weakens the basis of research, development and large-scale production on which civil aircraft . . . have depended.

"These changes have been going on for several years. Meanwhile, Government policy as at present on the official record is to make a financial contribution to research and development beyond what is needed to cover the needs of military aircraft, so as to support civil aircraft. But this contribution is to be progressively reduced in the belief that in time the whole cost of civil aircraft . . . development can be borne out of commercial earnings. . . .

"This policy presumes a world market for aircraft which will attract private risk capital voluntarily, in competition with other lines of investment. In fact, technological advance and political influence abroad are making the markets less attractive to private risk capital. The sums at risk in aircraft ventures continue to grow, for airframes, engines and equipment alike. So does the time-span over which investment is at risk. In international relations, aircraft production and exports are increasingly regarded by our competitors' Governments as instruments of national policy, especially now that Russia is plainly making a bid for the markets. Finally, all our serious competitors enjoy full support from the resources and mechanisms of the State.

"To summarize: Government policy presumes a progressive readiness in private sources of capital to invest at risk in a market where the magnitude of the risk is progressively growing for technological reasons; while the character of the risk is progressively being determined by political and strategic rather than by commercial considerations. Such a policy cannot succeed.

"The Council has decided to press for the implementation of certain measures as Government policy. These embrace:—

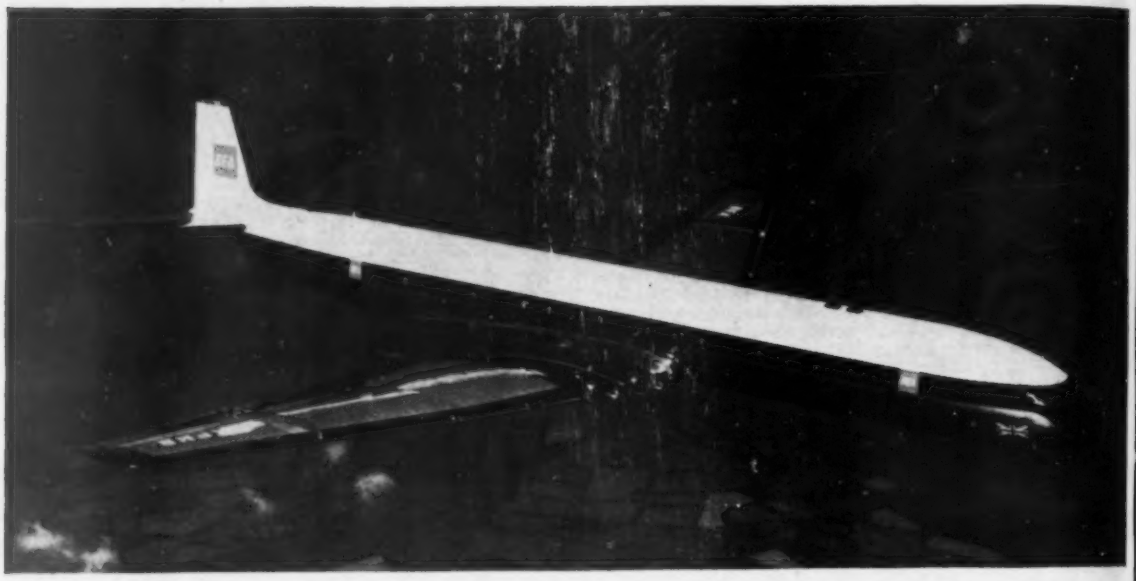
(i) Measures to harmonize the transport aircraft requirements of the Services, the airlines, and other potential markets at home, in the Commonwealth and elsewhere;
(ii) Measures to expand the volume of the home market;
(iii) Measures to make full use of the State airlines and the Services for operational development and proving of new aircraft, engines and equipment, including items which are not the specific requirements of those operators but have other potential markets;
(iv) Improved measures to facilitate sales abroad;
(v) Measures to expedite a programme of technical advance;
(vi) Measures to ensure a continued leading place for British aviation through defined Government financial support.

"In the Council's opinion, implementation of such measures will require, within the structure of Government administration, a focus of authority empowered to formulate positive, forward-looking national policies and programmes, and provided with the means of securing their execution. This is necessary to give effectiveness of form and purpose to a combined effort between the State and private enterprise in this industry.

"The Society has specifically refrained, at this stage, from formulating any definite ideas as to the form this 'focus of authority' ought to take. It might well be that if Departmental terms of reference were revised, no radical change of structure would be needed."

THREE GRACES FOR B.E.A.

One of the most powerful and pleasing visual impressions of the S.B.A.C. Display was that made by the three aircraft flying in the new B.E.A. livery—the Handley Page Dart Herald (left) the de Havilland Comet 4B, and (bottom picture) Vickers-Armstrongs Vanguard. In this scheme the wings are mainly red, the top of the fuselage white, and the cheat-line black, with red "B.E.A." squares. The Dart Herald was a nonconformist, having a black tailplane and rudder



Aeronautical Bookshelf

Air Aces of the 1914-1918 War. Contributors: J. M. Bruce, M.A.; Capt. E. F. Heyn, U.S.A.F.; D. A. S. McKay, D.F.M.; Major V. Houart; H. J. Nowarra; Miss J. Alexander; W. M. Lamberton. Harleyford Publications Ltd., Letchworth, Herts. Price 45s. Illustrated.

THIS is the most interesting book I have read for a long time on the air fighting of the First World War. So far as I know it is the first attempt to cover all the air aces of 1914-1918 irrespective of nationality, and it contains a wealth of information, much of which will be new to all students of that period and to the participants who at the time mostly fought against unknown foemen. Here the combatants who gained five and more victories are listed for British, American, Italian, Belgian, French, German, Russian and Austro-Hungarian air forces of both land and sea components. The quality of D. A. Russell's production may be gauged from my finding only four typescript errors during a careful reading of the whole text; and that of Bruce Robertson's editing from the smoothness of the reading of eight sections contributed by seven different writers.

A similar format is used in each section. First the military background of the national air force or forces is contained in an historical sketch, which, although necessarily brief, is ample to portray the scene and those mainly concerned with the creation and command of the air arms of the belligerents. This section is appropriately illustrated by photographs of the evolving aircraft and some of the personalities behind them or commanding them. Secondly comes a sequence of photographs and biographical sketches of individual aces, always interesting in portraying personalities and often in depicting combat techniques; indeed, it is fascinating to observe how strongly personal temperament influenced fighter pilots' individual tactics, the other chief influence almost universally arising from patriotism and fervid belief in a cause for which to fight. In this revelation this book is a silent condemnation of nationalism as a cause of war.

Total of victories by Nos. of airmen scoring						Total No. of airmen	Gross victory totals	Av. score per airman	Air Forces
20 and over		10-19		5-9					
A	V	A	V	A	V				
45	2,019	122	1,617	346	2,178	533	5,814	10.9	British
71	2,132	96	1,265	196	1,263	363	4,660	12.84	German
14	471	39	479	105	672	158	1,622	10.26	French
2	47	8	98	78	488	88	633	7.2	American*
5	125	5	68	33	205	43	398	9.05	Italian
4	131	11	145	15	107†	30	383	12.76	Aus-Hung'n
—	—	7	90	11	62	18	152	8.44	Russian
1	37	2	21	2	13	5	71	14.2	Belgian

*Includes six pilots who served only with the French Air Force.
†Total derived from known score of one pilot and average score of 14 pilots.
In the first columns, A=airmen and V=victories.

I do not know how the score lists were compiled, but I have compared the British list with another list in my possession. I found some amazing discrepancies between them. There are instances where the figures exactly tally, but more often they differ, sometimes widely. Frequently this book almost doubles a score; in one case it more than doubles it. It completely omits some British aces, for example the late Capt. C. E. Howell, D.S.O., M.C., D.F.C., who joined my flight* in No 45 Sqn. as a novice and scored 18 victories; I cannot imagine how he has been overlooked. On the other hand it seems extraordinary to list a pilot without a single decoration as having scored 19 victories; could this have really happened? In another case I do not believe the figure given; it could not have been reached unless that individual had won almost every victory by his squadron in his time with it, and he certainly did not. Again I found Thayre and Cubbon listed for 18 victories each; they were pilot and observer in an F.E.2d of No. 20 Sqn. and ought to be so bracketed. I have no objection to each receiving the credit, for they were a team, but if one were to add up the total of victories given in this list such means of listing would lead to inaccuracies in totals destroyed.

In war there is always the risk of overclaiming, because some individuals do shoot lines; but it is the task of the historian to examine such high scores with care, especially when they are unaccompanied by evidence in the way of equivalent decorations. Unfortunately, in the British list not all decorations awarded are shown. One pilot I knew with M.C. and Bar, D.F.C. and a foreign decoration is shorn of them all in this list. Perhaps as a result of the publication of this book we may arrive at a closer evaluation of the list of British aces, through information from first-hand sources while men who flew then still live.

This apart, here is a fine book wherein we find the at first timid Ernst Udet overcoming his preliminary fear; the amazing Nungesser fighting wounds as well as enemies; Philip Fullard portrayed as the brilliant fighter he was (although there is no mention of his going blind during one flight); defiant American Frank Luke; Italy's battling Baracca; Belgium's balloon-strafing Willy Coppens; Russia's Kazakov, who won three British and a French decoration in addition to Russian medals; and Brumowski, the Richthofen of Austro-Hungary. No one interested in the 1914-1918 air war can afford to be without this book, but readers should not take the score cards as accurate in every case. With that one reservation I can heartily recommend this book.

*This review is contributed by W/C. Norman Macmillan, O.B.E., M.C., A.F.C., who has also prepared, from "Air Aces of the 1914-1918 War," the statistical analysis above.

Aircraft and Missile Propulsion, Vol. II, by M. J. Zucrow. John Wiley and Sons Inc. (in England, Chapman and Hall Ltd., 37 Essex Street, London, W.C.2). Price 104s. Illustrated.

THIS, the second volume of a trilogy, can at once be classed as a significant contribution to the literature on gas turbines and propulsion machinery. The first work, published in 1958, covered the basic thermodynamic and fluid-flow theory necessary for an understanding of the subject. This second volume deals with the analysis of cycles and performance characteristics.

There are five chapters, the first of which is devoted to a discussion of gas-turbine powerplant cycles and the analysis of ideal cycles. The effect on the basic cycle of reheat, regeneration and intercooling, both separately and in combination, is examined, indicating that the book is not confined to airborne units. The other four chapters are devoted to the turboprop, the turbojet, the ramjet and rocket propulsion, the last also containing sections on the interior ballistics of solid-propellant motors and the thermodynamics of combustion processes. In each chapter the author is careful first to establish the criteria by which the performance of the plant may be judged, and then to develop the analysis around those criteria. This is an excellent approach, and adds considerably to the ease with which the student may follow the argument. The book is wholly devoted to performance analysis, but this must not be construed as a weakness.

Professor Zucrow's intention is to present the subject for students and for engineers who are not specialists in propulsion, but there will be few specialists who would not welcome a copy of this book to their shelves. The author has set out with the intention of making the work self-explanatory and in this he has succeeded admirably. Each step is carefully explained and the text is studded with worked examples. In addition, each chapter begins with a complete list of the symbols used—an example that might well be emulated by other writers. There are nearly 80 problems at the back of the book, references are copious and six extensive tables of thermodynamic functions are included for ease of reference. The book is written in good readable English (it is sad not to be able to take this for granted in textbook writing) and much trouble has been taken to make the many diagrams clear.

Few real criticisms can be offered, for Professor Zucrow is clearly a very able teacher. One omission of importance is a reference to the ducted-fan engine as an extension of the turboprop, and since he discusses the basic cycles of stationary units your reviewer would have liked an analysis of the free-piston gasifier. The lists of stationary and marine units are not fully up to date, except possibly those in the U.S.A., and those of turboprop engines stop short at 1950. H. M. B.

Heavenly Adventurer, by Basil Collier. Martin Secker & Warburg Ltd., 7 John Street, Bloomsbury, London, W.C.1. Price 25s. Illustrated.

IN 1919 British civil aviation began, and ended quite soon afterwards, without a subsidy. When it began a year or two later there was Government money for it to spend, and there were visions in the minds of the men who started it all that Britain would become —forget the appropriate cliché—mistress of the skies. Had they been given the gift of looking forward 30 years they would have seen their lack of wisdom in referring to such grants as "temporary."

It was the start of this civil flying which was the main aim in the life of the late Sir Sefton Brancker, the subject of this book. Brancker, who was appointed Director of Civil Aviation in the spring of 1922, was a venturous spirit. Before the First World War he had taken part in everything aeronautical which he possibly could, and had become one of the few officers in the British Army who believed in military aviation and was capable of teaching his superiors about it. His ability in doing so led to his being left in sole charge of the embryo air force when, in 1914, his chief in Whitehall was sent to France. Brancker had deep convictions including, ironically, one which told him that airships were not entirely safe and that the future of British civil aviation lay with large flying-boats. He perished in the wreck of the R.101—one of the first examples of lavish State subsidies for civil aviation.

It is a pity that Basil Collier's book is not very inspiring. It is too full of small detail, important to Brancker himself, but not seeming to bring out the full impact which this remarkable man really made on the early years of British civil aviation. A. C. B.

Missiles and Spaceflight

NASA FACES FACTS

Speaking last month before the fourth symposium on missiles and space technology sponsored by the U.S.A.F. Ballistic Missile Division, Dr. T. Keith Glennan, administrator of the U.S. National Aeronautics and Space Administration, had some straightforward comments to make on the American space programme. "We have had to face up to the fact that we simply cannot do everything that is proposed either by members of the scientific community, other agencies or by our own people," he said. "Some of the firing schedules we developed nine months ago lacked the realism that now characterizes our planning."

Speaking of the lessons learned during NASA's first year, Dr. Glennan said: "First, we have learned that we are not nearly as far advanced in space technology as we had thought or hoped. Our experiences in the space vehicle field have been less than completely satisfactory. The ratio of successful launches to what has been termed by some as 'successful failures' has not improved very much in the past year. And as soon as we began to plan for second generation experiments we found that we were facing some hard facts of life in the propulsion and guidance fields. Even today, every shot we make—either by the military or by ourselves in NASA—is a shot in which there is little or no margin for even a slight deviation from planned performance parameters. In thrust capability, in guidance-injection, mid-course and terminal—in thrust control—in all of these areas there is much that must be learned and applied before we undertake the difficult missions we all talk about so glibly.

"Secondly, it is becoming clear that we cannot and should not attempt to undertake all of the hundreds of projects that are being recommended to advance our understanding of the space environment. We haven't the manpower, the facilities or the funds.

"Probably more than any other single matter, the question that plagues all of us is one of reliability. When will we be able to count on being successful in launching and placing into orbit or on the desired trajectory in deep space as many as three out of four of our intended experiments? We should admit, quite frankly, that with distressingly few exceptions, we have not achieved complete success in any mission to date—success in the sense that the payload has been injected into orbit or into a deep space trajectory within reasonable limits of the planned flight objectives and in the sense that the payload has performed its mission satisfactorily."

Turning to the future, Dr. Glennan said, "Within the next year, I think you will be able to note an orderliness about the attack our people will be making in the space sciences area. We plan to concentrate our initial efforts in deep space on lunar missions—near miss, orbiting and hard and soft landings of payloads. In this programme we will develop the techniques necessary to accomplish missions into deeper space and will use them for such missions as their reliability and the opportunity permits. As to basic research and advanced technology, we expect to support greater effort in the universities, other non-profit institutions, and in industry in both basic research and in advanced development of systems components. As to booster systems, it is becoming increasingly apparent that greater efforts must be placed on simplification and reliability. As a corollary, it seems quite clear that continued attention must be given to reduction in the number and varieties of rockets and rocket booster systems for use in the space business. Finally—as in most other advanced technologies—a vast new area of materials research is being opened up by our space exploration requirements.

"From here on," concluded Dr. Glennan, "space research is going to be a matter of the same determined plugging away that has characterized aeronautics research—and, indeed, all scientific endeavour."

BIG JOE FIRED

The first launching of a test capsule under Project Big Joe took place from Cape Canaveral on September 9. The prime purpose of the firing was to investigate the behaviour of a fully instrumented capsule—similar to that which will carry the first man into space, under project Mercury—during a mission reaching a height of 100 miles and a speed of 17,250 m.p.h. In particular, the following were named as specific objectives: to determine the performance of the heat shield around the capsule and the capsule flight dynamics; to evaluate the forces on the capsule during flght; to effect its recovery; to test the adequacy of recovery aids aboard the capsule; and to check the procedures used in the recovery operation.

Unfortunately the boost system of the Atlas vehicle employed (bearing the serial number 628) failed to separate after burn-out, and this substantially curtailed the speed and altitude reached. What was to have been a journey of over 2,000 miles, terminated "several hundred miles north of Barbados," but the capsule was successfully recovered. On September 11 NASA said that the capsule "met all its main objectives"; Robert Gilruth, director of Project Mercury, commented that although the skin temperature reached 3,000 deg F, the temperature inside was never greater than 100 deg F.

On August 25 radar signals transmitted from the Royal Radar Establishment, Malvern, were successfully reflected from the Moon and received by the Electrical Engineering Research Laboratory of the University of Texas as well as by R.R.E. By comparison of the signals received at the two sites, the Ministry of Supply states, it is hoped to find out more about the surface conditions of the Moon and also how the Moon could be used as a reflector for transmitting radio and television signals for long distances over the surface of the Earth.

An indication of the exterior configuration of the Minuteman ICBM, has been given by *Aviation Week*. The first stage, some 25ft in length and 5ft in diameter, incorporates "the largest single solid-propellant grain ever cased," exhausting through four nozzles whose thrust axes can be varied to provide control. The second and third stages are shorter and slimmer, and also contain solid grains. Atop this is a guidance bay and above this again is the warhead and nosecone, the latter apparently being of the ablating type. From the outset Minuteman has been given by *Aviation Week*. The first stage, some 25ft in length graph below is the first to illustrate construction of these silos at Edwards A.F.B.

The first illustration to portray any hardware pertaining to an underground silo for a "hard" pad, this photograph depicts part of the casing of an experimental silo for Minuteman being loaded on to a railway truck at Boeing's Seattle plant. A complete silo is to be erected at Edwards A.F.B. for preliminary testing

Contracts for portions of the Minuteman ICBM system for the U.S. Air Force continue to be announced. Valued at $36,655,000, the contract for the nosecone and re-entry vehicle has been awarded to Avco; an ablative pattern will be used and prototypes have already been fired. On September 8 Boeing (assembly and test contractor) named Data Control Systems as responsible for the FM/FM ground telemetry station and Consolidated Western Steel for the missile servicing and umbilical towers.

Proving the final recovery by parachute of the Mercury capsule is now in full swing. Thirty drops, each from some 30,000ft, are being undertaken over the Salton Sea, Cal.

On September 15, two satellite-launching vehicles aborted on the pad at Cape Canaveral. One was the last of the Vanguards, carrying a satellite; the other was a Jupiter, laden with a variety of organic and biological specimens.

Preliminary data on the GG99 miniature displacement gyro have been issued by Minneapolis-Honeywell. Developed chiefly for short-range missiles and drones in which fast warm-up and high resistance to an adverse environment are important, the GG99 weighs under 4 lb and has a drift of 0.5 deg/min. It is energized by a gas cartridge.

Douglas Aircraft, prime contractors for the GAM-87A air-launched ballistic missile for the U.S.A.F. Strategic Air Command, are reported to have selected the missile and space vehicle division of G.E. to develop the nosecone and the inertial guidance system. According to *Aviation Week* Douglas have also been requested to submit presentations on behalf of Hughes and Northrop in respect of the guidance system. The GAM-87A is likely to bear a resemblance to Polaris; it is being matched to the B-70 Valkyrie inter-continental bomber.

A twelve-point space programme has been proposed to NASA by the Jet Propulsion Laboratory of the California Institute of Technology. Renowned for their past missile and space work, JPL suggest: A Lunar shot in August 1960; a shot "towards Mars" in October 1960; a shot "towards Venus" in January 1961; a hard Lunar landing by June 1961, using a retro rocket and radio telemetering immediately before impact; a Lunar satellite in September 1961; a satellite round Venus in August 1962; entry into the atmosphere of Venus; a Mars satellite in November 1962; entry into the atmosphere of Mars; a Lunar orbit and return; a soft landing on the Moon in June 1963; and a soft landing on Venus in March 1964.

A FULLY MOBILE SURFACE-TO-AIR WEAPON SYSTEM FOR THE BRITISH ARMY

BY 1948 it was clear that, if Britain was to retain her place in world aviation and be adequately defended, a new industry would have to be created—a missile industry. Major aircraft and engineering firms were chosen by the government to receive development contracts for a number of defensive guided-weapon projects, and in October 1948 the Ministry of Supply decided to place a major G.W. contract with English Electric as soon as that company had a team of scientists ready to accept such a task. Thus were the early arrangements made for the incubation and hatching of Thunderbird.

Their assignment was described as "the development of a ground-to-air guided missile," and the first step a study contract under which English Electric would examine the entire problem and make suggestions for suitable hardware. It was understood from the outset that the company would, if its studies showed that an efficient weapon was feasible, have responsibility for its development—and, in all probability, its manufacture in quantity for the Services.

Planning the embryo of the company's now very extensive Guided Weapons Division began some months before the formal issue of the study contract. Mr. L. H. Bedford, who was then working at the Marconi research laboratories at Great Baddow, Essex, was appointed to take charge of the new Division. The first plan was to form the division close to English Electric's vast works at Stafford by taking over a nearby R.A.F. maintenance unit which was being run down; but the M.U. was given a new lease of life in the R.A.F. re-equipment programme which was then beginning, and plans had to be re-drafted. From Stafford the egg of the Thunderbird was taken to Luton, Beds, where D. Napier & Son, a member of the English Electric Group, had a major works. So here, early in 1949, a Seco-type hut was purchased from the Ministry of Works and erected within the Napier perimeter at Luton airport. The cost: £3,400. This was the beginning of what is now the largest guided-weapon factory in Europe and which today, 11 years later, is still expanding.

These preparations meant that when the Design Study Contract was subsequently issued by the Ministry of Supply the company was ready to begin real work on it immediately. The contract called for "study and experiment in collaboration with the Director, Royal Aircraft Establishment . . . of the main and ancillary problems of a ground-to-air guided weapon" which was to be capable of "efficiently defeating single or mass attacks" by bombers of the future. It called, too, for a comprehensive review of the techniques involved, and detailed recommendations on the shape, size, propulsion, guidance and control of the weapon. Payment for the contract was on a basis of costs, including overheads, plus a small percentage profit, and the maximum figure was to be £100,000 "except with the prior written approval of the Director of Contracts."

All these arrangements were made under the closest security restrictions. The organization was not even called the Guided Weapons Division, but sheltered under the pseudonym of Navigational Projects Division. The project itself was initially given the Ministry code name of Red Heathen, but this later became Red Shoes. The company interpreted the contract to mean that it should not merely produce a design which would meet a particular requirement, but that it should be concerned as closely as possible with the ultimate performance of the weapon in Service hands. This consideration has always been paramount in English Electric's mind throughout the development of the entire weapon system.

The period devoted to the design study was an extremely busy one for the small team of engineers which Mr. Bedford assembled at Luton. Seventy technical reports were issued in twelve months, many of them over the names of Mr. Bedford, Dr. E. K. Sandeman, Dr. R. W. Williams, L. J. Ward and J. Cattenach and J. M. Noble and M. Dowlen also contributed considerably to these studies. The first subject to be studied was the radar aspect of the system and the homing method. The main consideration was given to active and semi-active homing, and it soon became clear that the latter had the better range potential. The final recommendation was for a semi-active homing system. To study homing trajectories the study team devised a particularly successful simulator system, and this work was closely linked to that on the control system for the missile.

Among general problems of missile design the choice of propulsion was a prime consideration and rocket, ramjet and turbojet propulsion was investigated. The study teams felt that supersonic ramjet and turbojet systems were not sufficiently advanced for either to be used as the basis of a programme. The only alternative was the rocket motor which, in the study team's opinion, also allowed the use of more attractive propellants than those consumed by the alternative types of power.

In particular, an eye was kept on solid-rocket technology, which was even then beginning to show promise of superiority in specific impulse over the liquids. However, the availability of suitable solid fuels was doubtful, and it was decided to start off with a liquid-fuel rocket—a decision which also allowed the team to examine the behaviour of variable-thrust motors. The problems of missile design were dealt with jointly by the Guided Weapons Division and by a Napier team which did a great deal of the detail work (Napier were at this time actively concerned with liquid rocket motors, which eventually led to the single, double and triple Scorpion aircraft engines.) At this stage it was envisaged that the missile would have four separate control fins.

All these conclusions were included in the design study report which was submitted to the M.o.S. This document stressed the importance of getting both small-scale and full-scale trial rounds into the air at the earliest possible moment. Here again English Electric were showing their anxiety to get a usable weapon into the hands of the Services.

Five months later the development contract for Red Shoes was received. The details of this were based on the conclusions of the company's study report, and made English Electric responsible for the whole weapon system, except for the ground radars, fuze and warhead. Within a month of the contract the first small-scale missile firing took place at Larkhill, Wilts. This was the first of a provisional programme which called for many similar firings to check the basic aerodynamic design. The use of small-scale missiles, boosted to high speed but without actuators to move the control fins, reduced the cost per round very substantially, and facilitated the measurement of aerodynamic constants.

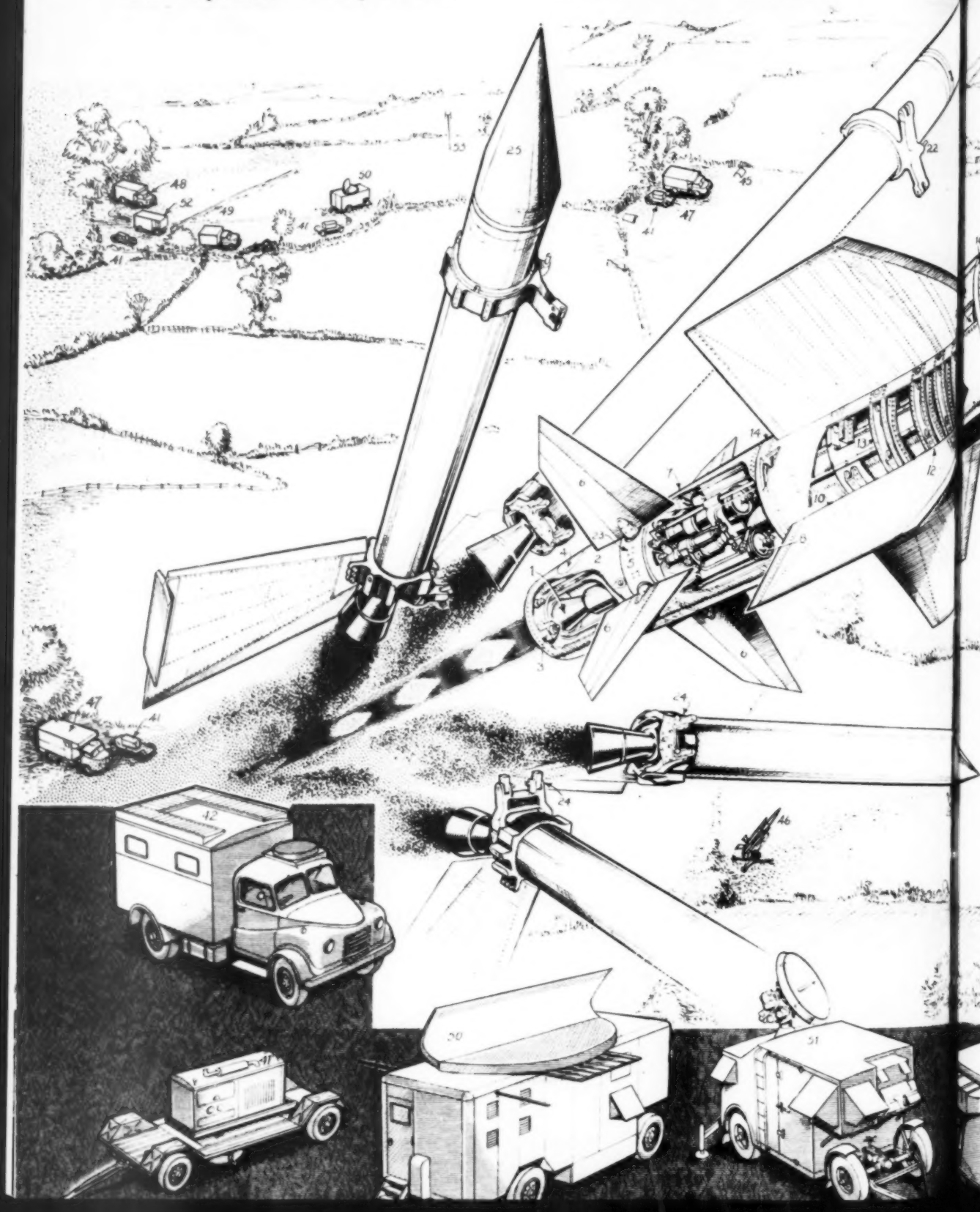
At this time the whole project was fairly evenly shared between English Electric and Napier. It was appreciated that such a division of responsibility would not be satisfactory as the magnitude of the programme grew. It was therefore decided that much of the Napier responsibility should be taken over by the parent company, and more than 30 designers and technicians were transferred from Napier to English Electric during 1951. This administrative reorganisation was greatly helped by the fact that Sir Conrad Collier, a director of Napier, had in December 1949

(*Continued on p. 298, after double-page drawing of Thunderbird*)

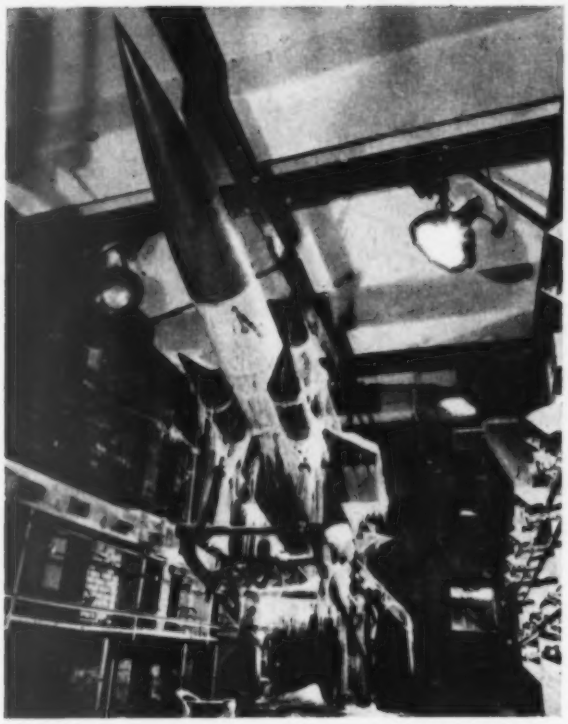
THUNDERBIRD . . .

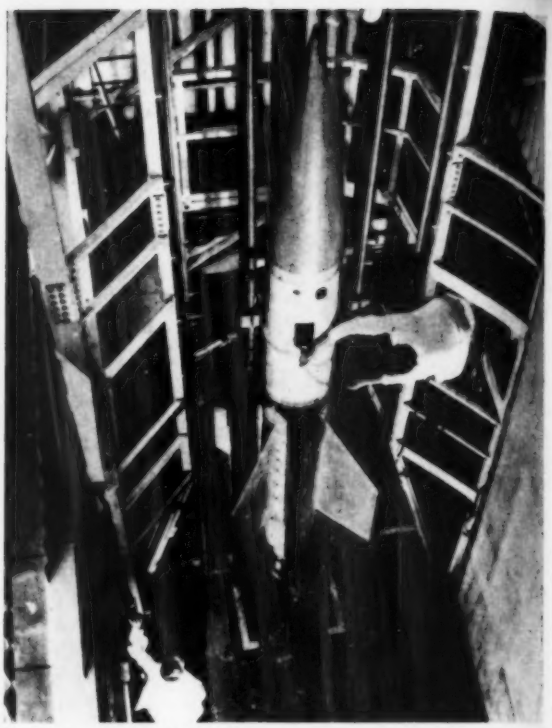
The System in Operation

1 Motor nozzle
2 Boat-type tail
3 Launcher socket fly-off head
4 Telemetry aerial plate
5 Breakstem ring
6 Control surfaces
7 Aft-body
8 a.p.u. gas generator
9 Centre-body
10 Solid-propellant motor
11 Cable-duct
12 Wing attachment points
13 Main torus frames
14 Manacle rings
15 Warhead bay
16 Removable panel
17 Forebody
18 Jury beam



28 Road axle trunnions
29 Hinged outriggers
30 Levelling jacks
31 Elevating ram
32 Launcher-loading rollers
33 Zero-length arms
34 Pivot and quick-release point
35 Towing point
36 Crated delivery to FATP
37 Mobile crane
38 Uncrating
39 Assembly trolley
40 Assembly-trolley rails
41 Generators
42 Sensitivity test vehicle
43 Tested round to transporter
44 Ready-use area
45 Shelters
46 Mobile launchers
47 Launch control post
48 Battery control post
49 RT post
50 Tactical radar
51 Tracking and illuminating radar
52 Radar display vehicle
53 I.F.F.
FLIGHT COPYRIGHT





As outlined in the text below, the guided weapon division of English Electric Aviation have their largest plants at Stevenage, Herts, and Luton, Beds. Above, left, is an icicle-festooned Thunderbird at minus 20 deg C at Stevenage; in the other picture the complete round, with dummy boosts, is pictured undergoing shock testing in a drop tower at Luton

THUNDERBIRD . . .

assumed the post of chief executive of the Navigational Projects Division. At the end of 1951 R. P. E. Tabb was appointed deputy chief engineer of the Division; he had been one of the company's key engineers at Stafford, and his transfer to Luton marked the real start of the expansion of G.W. activities, and since that time the division has been a major part of the aviation interests of the Group. It soon outgrew the rather limited space available at Luton, and it became clear that a major expansion in floor-space and manpower would be necessary to complete the Red Shoes programme and the subsequent projects which were likely to arise.

By 1951 the solitary Seco hut had expanded to nine huts with an aggregate floor-space of 45,000 square feet. It was hoped to expand still further at Luton, but the Town and Country Planning Act prevented this and the company looked instead to Stevenage New Town, in Hertfordshire, where new industry was being encouraged. Another company which had been planning to occupy a large site in the Stevenage industrial estate was offered an alternative home and the plot originally earmarked for them was offered to English Electric. In August 1952 it was decided to build the new factory at Stevenage, and this plant today employs about one third of the town's working population.

This move greatly eased the problem of housing employees, and the Stevenage site was also large enough to allow for major expansion. It was abundantly clear that the resources and manpower needed to complete a single major guided-weapon project could not be housed in Seco huts and that, having assembled everybody under a more suitable roof, further projects would almost certainly come along. This has materialized in the "successor to the Thunderbird" which has already been announced, and the scope of the Stevenage factory is proving that two or more projects may be efficiently carried on simultaneously. Construction of the first facility—the "pilot factory," wherein cartoonists inferred English Electric was producing robots to test automatic aircraft—began shortly after the site agreement had been concluded with the Stevenage Development Corporation. This part of the works now houses the Instrument Wing, producing—among other things—licensed versions of Minneapolis-Honeywell floated gyros for inertial systems.

Following closely behind the flight trials of small-scale missiles at Larkhill came the firings of the first really representative Thunderbirds—the liquid-fuelled D.3s. These missiles had boost, control, guidance and auxiliary power systems, which were designed to assist the development of later versions of the weapon rather than the specific missile under test. This proved valuable because these early missiles differed considerably in detail from the Thunderbirds now being delivered.

In all 153 small-scale rockets were fired at Larkhill between 1950 and 1955. During this time the programme for the D.3 got well under way, and the R.A.E. range at Aberporth on the Cardiganshire coast was also brought into use. At this range English Electric, together with other major guided-weapon contractors, were provided with facilities for carrying out complete flight trials. It was from here that the first D.3—the full-size Thunderbird fledgling—was fired, at 7.15 p.m. on July 15, 1951. The round "flew satisfactorily"; but the blast from the boost motors blew away one of the launcher ramps "which," the report added laconically, "consequently would require modification."

This first round travelled from the Luton works with a small team led by T. J. Dorricott, then the company's trials engineer. It was the first firing of its kind ever carried out by the team and the complete operation, from the arrival of the round at Aberporth to the firing, took a fortnight. It was achieved in the face of several minor, but time-consuming, difficulties, and it forms a striking contrast to the matter of minutes in which Thunderbird can now be fired in the field.

Following on this success, the complementary D.4 programme had been put in hand. This was a development of the D.3 but with a solid rocket motor, which was considered more suitable for Service use. A large number of these missiles were fired, and many were launched against Firefly drones and targets hung from captive balloons. These more realistic trials proved the basic reliability of Thunderbird, and it was decided to go ahead with a re-engineering of the missile system as a whole, to change the weapon from one which could be successfully flown only by white-coated boffins to one which could be successfully and accurately brought into action by khaki-clad National Servicemen.

This involved cleaning-up the design and incorporating all the modifications which had taken place throughout the development programme, to evolve the optimum production weapon. One of the main improvements was that it enabled the Services to exploit to the full the advantages of repair by replacement. In its production form the missile consists of seven discrete assemblies; and, as higher performance is required, each portion can be replaced by a more advanced component without interfering with the rest of the missile.

Less than a year later the first of the re-engineered missiles was fired, and since then many further rounds have flown both from Aberporth and in South Australia at Woomera. In these trials Thunderbird has obviously achieved some spectacular successes. Film has been released of a direct impact on a Jindivik which was simulating a modern bomber. Other evidence of successes has been in the form of still pictures from near misses against Meteor and Firefly targets. So far there has been no news about Thunderbird being in action against the Canberra U.10; but it will be an interesting day when English Electric's guided weapons division shoots down an aircraft designed by the aircraft division!

Progressive intensification of the flight-trials programme led naturally to the formation of company trials units at both Aberporth and Woomera. The latter establishment increasingly assumed responsibility for the flying owing to its greater range area

and vastly better weather. These two factors meant that trials could be carried out regularly, and the hardware could be collected —albeit somewhat crumpled—from the bush-country down-range. But there was one major disadvantage: Woomera is 10,000 miles from Stevenage. Although air freight is now common, in the early days the missiles were sent by sea, and accordingly were "lost" for development purposes for long periods. In consequence modification kits were made up after the missile had been sent, for onward posting by air. Incorporating the modifications at Woomera meant that a fairly large and highly qualified trials team had to be permanently established there. This Australian Trials Unit was set up early in 1953.

With the Australian firings arranged it became essential to perfect some system permitting relatively gentle recovery of rounds. A recovery system was devised which would use air brakes to decelerate the missile at the end of its useful flight, a 6ft ribbon parachute to slow it down still further, and finally three 14ft parachutes to reduce the fall to 50ft/sec. The special parachutes were developed by the Irving Air Chute company. Various stages of this recovery system were tested at Aberporth, in wind tunnels, and on other test rigs at Luton. The final system was perfected on D.4 missiles, and was made easily applicable to the Service version of the missile. It employed three airbrakes positioned radially, with a two-stage parachute brake. The first stage comprised a 9ft ribbon parachute and the second three 15ft canopies. This system rescued numbers of D.4 missiles, which were very little damaged and were fired again.

This is the early history of Thunderbird. The latest achievements may not be discussed but enough details have been permitted in the ensuing text to show that this fully mobile weapon, which is now in service with the British Army* will, in all probability, become one of the premier defence weapons of the Western world.

Design and Structure. Although the foregoing has dealt at length with the Army's surface-to-air weapon system as a whole, very little has been said about the missile itself. Security restrictions naturally preclude the publication of any details of performance, or of the precise types of receiver aerial, guidance system and warhead employed, but it is possible to talk in general terms about the airframe, propulsion system and certain other aspects.

Like several other British missiles (but unlike the majority of surface-to-air weapons in the U.S.A.) Thunderbird has a cruciform of low-aspect-ratio wings and a rear cruciform (indexed in line with the wings) of sharply tapered control fins. In the original liquid-propellant Red Shoes test vehicles it was naturally possible to store the propellants symmetrically about the c.g. and pipe them to a thrust chamber housed within the boat-shaped tail. The switch to a solid-propellant motor meant that the hot exhaust gases had to be ducted through a tube leading from the propellant charge to the divergent nozzle at the rear. Losses in motor tubes of this type are naturally fairly high and, to minimize length, the production missile appears to be rather shorter aft of the wings than the liquid-propellant version. This in turn has reduced the moment arm of the control fins, so that the latter have had to be enlarged.

A circular cross-section is maintained throughout the body. The first 5ft of the body is formed by a large ogival moulding in dielectric material. This moulding appears to be an outstanding example of the plastics engineer's art, since not only must it have maximum transparency to the vital radar signals upon which the missile homes, but it must also transmit these signals with practically zero refraction, while from the structural viewpoint it must withstand immense flight loads, as well as the shattering impact of rain or hail at a speed of around M2. The radome proper is in Bakelite polyester resin, with a bonded-on nosecap of compression-moulded phenolic material.

To the rear of the radome are sections housing the guidance receivers (and doubtless other elements of the guidance and control system), the warhead (which appears to occupy a large bay just ahead of the wings), followed by the solid charge of the sustainer motor. For reasons of security the fore and aft limits of the latter may not be revealed, but it seems safe to assume that the length of the charge is at least as great as the root chord of the wings. Surrounding the motor tube aft of the wings are the auxiliary power unit and the actuators which move the control fins. Each body-section is fabricated in heavy-gauge light-alloy, and special quick-release manacle rings are employed to clip adjacent sections together. As already noted, the latter operation is done in the field by soldiers of the unit to which the missile is assigned, and it is therefore of paramount importance that the coupling together of sections—and of the many electric, hydraulic, pneumatic and other types of supply which pass from one section to the next—shall be effected rapidly and in a foolproof manner. It must also be remembered that the bending loads experienced by a body like that of Thunderbird are exceedingly great and the entire load must be borne by the manacle rings alone.

As the main cutaway drawing shows, each wing is through-bolted to five strong circular frames in the centre body. In the original Red Shoes test vehicles the wing anchorage stood proud of the body profile and the wing roots were faired by long axial bulges. Removal of the latter has doubtless increased the performance of the weapon.

Each of the four wings has a sharply swept leading edge, straight trailing edge and square-cut tip. It will be recalled that Seaslug has rectangular wings, and the reason for the acute leading-edge sweep of Thunderbird may be an aeroelastic one. Fabrication of the wings appears to be quite conventional, the spars lying perpendicular to the airflow and the skin being heavy-gauge light alloy with flush riveting. The leading and trailing edges seem to be machined from bar stock. Control fins are tapered on both leading and trailing edges and their tips are cropped at the Mach angle. Each fin is machined from a solid slab of light alloy and is retained by a multi-bolt fork fitting on the end of the fin shaft.

Brief details of the auxiliary power unit were contained in our issue of September 12, 1958. Although probably differing in detail from the unit employed in the production weapon, the control unit exhibited in cutaway form at last year's S.B.A.C. show gave a clear indication of the principles adopted. Gas pressure is obtained from the controlled combustion of a solid charge and is used to energize the control actuators directly.

The Weapon System. A workable missile having been evolved, it was the task of the engineers at Stevenage, working closely with the Army, to integrate it into a comprehensive weapon system capable of discharging its functions with maximum reliability under the most adverse battlefield conditions. Moreover, the complete system had to be developed to be compatible with existing British early-warning radar and control/reporting systems.

In common with most radar-directed missiles, the Thunderbird weapon system consists of units linked together electrically or

(*Continued on page 302*)

**See "Thunderbirds at Manorbier," "Flight," June 5, 1959.*

All portions of the Thunderbird weapon system may be mounted on wheels. Three of the most important are the tactical control radar (left), the tracking and illuminating radar (below, left) and the wheeled base of the launcher (below)

A NEW TILT AT A PEACEABLE WINDMILL

A novel aspect of the prototype of the Fairey Rotodyne VTO airliner, powered with two Napier Eland gas turbines and Fairey pressure-jets

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Straight and Level

JUST after dark the other night I was walking up Whitehall. The weeks of heat had passed, and I knew we had had the summer. It was really quite cold. Suddenly there was a Spitfire on the pavement: a Mark 1, on a pedestal, floodlit and daubed with paint. An aircraftman stood with it. He was very young and slim and I hoped he had had his dinner. In the glaring floodlight the Spitfire's wing looked as though it had been bashed out of Plasticine, it was so lumpy and rough. Just by it was a lamppost with a litter bin on it, and a shaggy tramp was delving very deliberately. There was a young chap, too, with a girl, and he took her by the hand and said with a German accent (and this is so true the whole thing seemed complete fantasy), "A Mosquito." And, perhaps because the girl didn't say anything right away, "A Hurricans I mean." Then they both cuddled round to the front and read on a board that it was a Spitfire. By now the girl didn't care anyway.

● I carried on up Whitehall and went into a pub and bought a drink and read the paper, and there was Mr. Nixon telling me that the Russians had missed three moon-shots in two weeks, and anyway how did we know that they had really got there. Then Mr. Selwyn Lloyd assured me that most people weren't terribly interested. Mr. Truman said he never believed the Russians anyway unless he could see for himself.

When I left the presence of these great men and went out into Whitehall again it somehow seemed chillier than ever. Then something reminded me that Spitfires hadn't really been made out of Plasticine, and things seemed a little warmer and cheerier. Of course, it could have been that drink.

● For most people five days of Farnborough are just about enough, what with Farnborough feet, Farnborough flush and the horrors of Hog's Back. But for *Flight's* photographers it all starts three or four days beforehand and finishes the day after. During that extra time their fine brown frames are themselves usually framed in the doorway of an airborne Hastings. The services of this aeroplane are laid on by that most benevolent of Ministries (at Farnborough-time anyway), the M.o.S.; and it is conducted round the Hampshire sky by the most patient of R.A.E. pilots. Thus, for a few hours, this imposing equipage truly becomes a queen of the air, commanding in turn the flower of Britain's test pilots to rein in their mighty steeds to bear it company. And the pilots really enter into the spirit. In fact, "Bea" in his Lightning just about entered into the photographic aircraft. (In this instance a Lincoln: see *Flight* last week.) Ron Gellatly showed how the Roto got into Rotodyne (opposite).

● Low fares, low fares, low fares. It is astonishing how persistently these words have been spoken and written during the last year.

Low air fares are news. Newspaper editors nowadays rate stories about them as high as they rate stories about supersonic jet wonder planes, etc., because Mrs. Jones of Chorley Wood (the tribunal of popular journalism) is interested in low air fares. Price appeals more to her than speed.

Meanwhile the airlines, including the British Corporations, charge international fares that are almost all higher than they ought to be. They talk bravely and big about economy fares, emphasizing that they are a Splendid Thing. But I am not sure that they are pressing for *real* economy fares.

* * *

"We all know what everyone needs," writes Frank Robertson in the Swiss magazine *Interavia*. "The man in the streets wants cheaper fares. The airline operator wants more traffic. The aircraft manufacturer wants more orders.

"The solution is childishly simple. Build aircraft with lower direct costs, pass this reduction straight on to the ticket buyer, watch the traffic rise and the overheads fall, and then pass the drop in overheads also on to the ticket buyer. . . . Being British I should naturally like to see the British Commonwealth giving a lead in this matter."

● I am impressed with what the managing director of D.H. Holdings, Sir Aubrey Burke, writes in a pre-Farnborough article: "Statistics suggest that if the airlines can afford to reduce their fares by 20 per cent, they may well increase their traffic by as much as 60 per cent. I suggest that if we can keep our eyes on this ball the future for the British aircraft industry is bright."

And I was delighted also to hear Charles Gardner's commentary in the B.B.C.'s television broadcast of the S.B.A.C. Display. Taking great care not to over-emphasize the low fare potentialities of his own firm's product, the Vanguard, or to undersell the jets, he fastened on to the Argosy as the symbol—together with the Vanguard—of Britain's bid to get ordinary people into the air at fares they can afford.

This was the message of the 1959 Farnborough, but it was the B.B.C. more than the S.B.A.C. who put it across.

● There is something very satisfying about precise data. It is, for example, comforting to know that the span of a Britannia is 142ft 3½in; one cannot argue about it or quote "an eminent authority" who thinks it should be 142ft 3¾in.

In contrast, the world's astronomers, cosmologists and astronautical space mathematicians seem to have agreed to differ substantially on the actual distance travelled by Russia's Lunik II on its recent trip to the Moon. Merely by skimming through the British national dailies one can turn up the following numbers of statute miles: 233,600 (*The Times*); 235,000 (*Daily Mail*); 235,487 (*The Guardian*); 236,875 (*Daily Telegraph*); 239,000 (*Daily Mail* again); and 240,000 (*Financial Times*). I particularly appreciate the disarming schizophrenia at Northcliffe House.

● At the Helicopter Association's dinner the other week a colleague heard no less an authority than the president, Mr. N. E. Rowe, insist that the correct pronunciation is "heelicopter."

Which, in view of the fact that one talks about a "heelix" rather than a "hellix," seems reasonable. On the other hand, three out of four good dictionaries I have consulted settle for the short e.

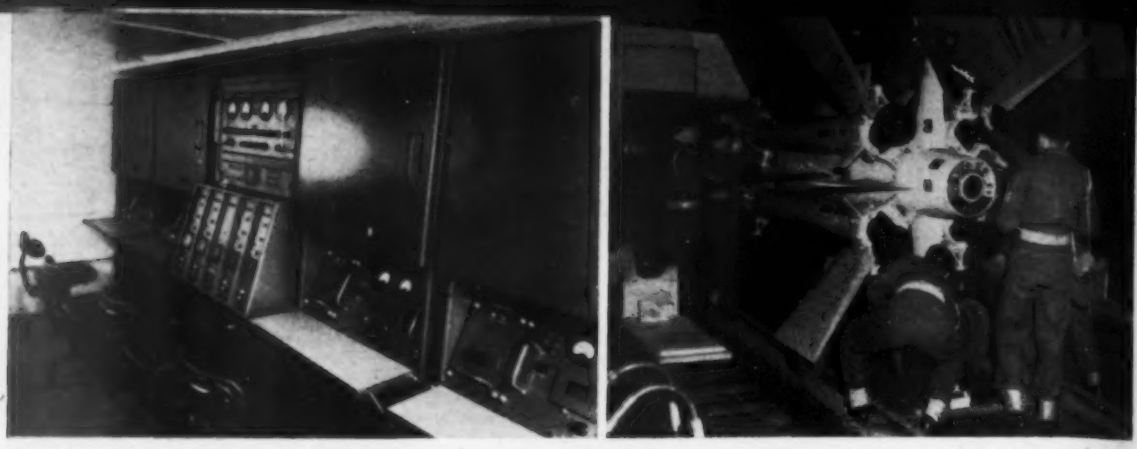
Incidentally, the helicopter (or heelicopter) boys are now referring to fixed-wing aircraft as "frozen-wing aeroplanes."

● An article in a newspaper for Top People discusses the jargon which enables aviation experts to set themselves apart. Here is an extract:—

"Before inquiring for a QDM or a QNH, a captain would not think of using such an ordinary phrase as: 'Can you hear me?' Nor would the control tower risk losing its witch doctor status by answering: 'Yes.' The question might be framed: 'How do you read?' And the reply: 'Five by five.'"

ROGER BACON

New at Farnborough: The Blackdyne Rotoburn



Organization and functioning of the Thunderbird weapon system is outlined in the text below and opposite. Above, left, may be seen the interior of the launch-control post, while in the right-hand photograph a drill round (an inactive dummy used for familiarization training) is being manhandled by troops of the Royal Artillery in the field assembly and test point

THUNDERBIRD (Continued from page 299)

electronically. The largest indivisible piece is the tactical control radar (TCR) on which the incoming raids are resolved into individual targets and allocated to weapon sites where each is acquired by a tracking and illuminating radar (TIR). The basic operational unit is the fire unit (FU). This comprises a single TIR and a varying number of associated launcher/missile combinations. The TIR provides information which, after it has been processed in a computer, controls the azimuth angle of the launcher to ensure that the missile is launched on to the target sight-line. The number of launchers comprising a fire unit depends on the particular operational situation, and can be up to a total of eight.

All units of the weapon system are designed to be transportable in a vehicle convoy at normal road speeds, and to be capable of traversing "cross-country terrain" without damage to any part of the system. All portions can be accommodated in normal Service vehicles.

Site Organization. The Thunderbird weapon system can be deployed in either a fixed or a mobile form. In the former case the launch control post (LCP) would be largely underground, in a reinforced-concrete structure. In the mobile role the LCP is accommodated in a 3-ton truck together with a 1-ton power trailer. Within the LCP are contained a line-of-sight computer, one or more operators' consoles and a launch control officer's (LCO) console.

From the consoles it is possible for an individual operator to set up from one to eight rounds. The pre-flight checks and calibrations may be automatic or semi-automatic; if the latter, a trained operator is required to go through the prescribed drill with a nine-position switch and a scan oscilloscope. The LCP is connected both to the launcher and to the TIR and battery command post BCP by cable.

In the mobile role numerous forms of deployment are possible. The normal FU is an Army battery and this generally consists of a firing troop and a servicing troop, the former containing four launchers, all controlled from the BCP. In the BCP the target selection officer has a display remote from the TCR incorporating IFF interrogating facilities and a means of "putting on" the TIR. Target position information from the TIR is fed to a computer in each ICP and the output signal used to align the launcher(s) to the target sight line(s). These functions are carried out remotely and entirely automatic.

Site topography may impair radar performance and correspondingly reduce early-warning time. To minimize this effect individual monitoring equipment is contained in the LCP for each missile/launcher combination, so that rounds can be made available for firing at the earliest possible moment.

Fire control is actually effected by employing a comprehensive sequential lamp display in each LCP, linked to a control display in the BCP. Fire order and salvo size is determined by the fire commander in the BCP, the actual instant of firing being determined by the LCO (who also completes all fire circuits to ensure the safety of battery personnel). The LCO also has an additional sequential-lamp display for each ready-use area for instructing the loading attachments. Carefully inserted inter-locks throughout the system preserve the safety of the loading detachments and minimize interruption to the activities at adjacent launchers.

How the System Works. Rounds are delivered from the factories of English Electric Aviation Company in either of two conditions. In the first instance the complete missile is dismantled and delivered as a series of packaged sub-assemblies, each of which is protected in a special container and can be brought up to what is known as "cigar" standard (i.e., complete missile less wings, warhead and radome, control fins and boost motors) by a skilled team of Service personnel in some quarter-hour. Alternatively Thunderbird may be received as a fully assembled cigar in a special transit container, incorporating advanced forms of shock-proofing and air-conditioning to keep the missile protected for at least two years in any normal environment. In either case the missile is conveyed as a cigar in its transit container for final assembly in the operational area of the battery concerned.

Once delivered to the unit the missile is taken to the FATP for testing before delivery to the launcher. The cigar is unpacked and mounted on a wheeled trolley, and subjected to an overall test for serviceability. Should it fail this test, diagnostic test equipment is brought to bear and all faulty units are replaced forthwith. No maintenance as such is ever done on an assembled missile, the standard procedure being immediate replacement and retesting. All the test equipment is mounted in vehicles.

Once the newly received round has passed its serviceability test it is completed by the addition of the warhead, radome, wings and control fins. The last pieces to be added are the four boost motors, and the round is then placed on the launcher elevating frame.

The Launcher. As the illustrations show, the launcher consists essentially of a fixed chassis on which is mounted a turntable base designed to accept the separate elevating frame which carries the missile. In the static role the launcher is grouted into concrete; in the mobile role it is in the form of a four-wheel trailer which may be set up on any smooth ground. The wheels and axles are removed, the complete assembly picketed to prevent lateral movement and the base finally levelled by four hand-operated jacks, one at each end and two on the hinged side arms. The rotating base is driven by a servo-control system which slews the missile to the correct azimuth angle, according to the signals received from the TIR. The elevating frame is positioned at a fixed elevation of 50 deg.

Various methods may be employed to load this elevating frame on to the launcher base. One method is to tow the frame on a standard Service trailer fitted with a turntable. When the trailer nears the launcher the elevating frame can be pivoted through 90 deg to bring the rear of the frame round to the base of the launcher. Short rail sections can then be inserted to link the trailer and launching base and permit the frame to be pushed backwards on small flanged castors until it engages in the launcher trunnions.

When fully home the elevating frame is finally secured by a pair of rotary shafts which are turned manually to lock the assembly. Elevation is accomplished by a single hydraulic ram carried on the launcher base. As already noted, missile services are connected through the fly-off head, which is locked against the base of the missile and provides multipin electrical and pneumatic connections.

Working backwards from the fly-off head, the multiple services are connected round the elevating frame and moving portion of the launcher to the fixed base, by way of a special cable harness which permits the missile to be traversed. In addition to servo-motor signals, hydraulic supplies for the missile and elevating frame are passed continuously from the ground equipment together with 400 c/s, 3-ph current for the missile, and cold air to the electronic pack.

Once established on its launcher the Thunderbird should be capable of being left for up to two years, irrespective of climate. Periodical servicing checks may be undertaken, and the missile and its ground equipment can be logically broken down into a number of individual assemblies and components, in order to minimize the loading on repair depots and simplify the range of spares holdings necessary for field maintenance. Test equipment has been developed for all Army echelons, all such equipment

being engineered to meet the hazards to vehicular mounting.

Firing and Flight. Security considerations preclude the publication of details of the readiness time of the Thunderbird system, but it is naturally exceedingly brief. Moreover, facilities are provided to permit the complete system to remain at an advanced state of readiness for long periods.

In the event of an alert being signalled, final preparations of the missile, slewing the launcher to the correct azimuth angle, and the actual firing are all conducted by remote control from the LCP. The fire-control facilities permit single-shot, ripple or salvo operation. The single-shot kill probably is exceedingly high, but for truly vital targets one would expect a salvo to be chosen.

The sequence leading up to the actual firing has already been described. Missiles are actually fired by the LCO when the appropriate circuits have been completed. At the moment of firing, all internal systems become energized and the missile is pointed in the general direction from which the target is approaching. Closure of the firing circuit ignites the four boost motors together. Their thrust imparts an exceedingly high longitudinal acceleration and permits the missile to leave the launcher cleanly, even though the latter is of the zero-length pattern.

The boost phase lasts for approximately 3 sec. At the end of this time the boost motors are exhausted, and their thrust dies away until it becomes less than the aerodynamic drag load on the boost cases and their stabilizing fins. When this occurs all four motors slide to the rear, and in so doing are released from their front anchorages. The offset nosecone on each motor imparts a considerable outward thrust which causes the four spent packages to petal outwards, pivoting about their rear hinges. This rotation is arrested by a mechanical stop, but the angular momentum of each motor is so great that the four rear hinges shear off flush with the airframe, leaving the latter aerodynamically clean.

Immediately before boost-motor burn-out the internal sustainer is ignited; the latter thereafter provides a much lower thrust to maintain cruising flight at a high supersonic Mach number. Throughout the remainder of its flight internal power for the Thunderbird is provided by an auxiliary power unit mounted in the aft-body. This unit is energized by a slow-burning cordite charge, the filtered gas from which is passed through a small turbine driving an alternator and hydraulic pump. Test and pre-launch checks can be effected by external electric and hydraulic supplies fed through the fly-off head; at the moment of launching the latter's self-sealing connections are broken and the auxiliary power unit is ignited along with the boost motors.

A proportional-navigation type of flight profile is followed by the Thunderbird during its homing course on to its quarry. The homing head locks on to an incoming signal which is the echo from the target of the powerful signal transmitted by the "lamp" set on the ground.

In the guidance receiver on board the Thunderbird the incoming signal is processed to produce error signals in two planes. These error-signals in turn are used to precess the gyro system to correct any misalignment which may exist between the major axis of the missile and the axis of the receiver dish. These error-signals are transmitted to the control system.

Self-contained servo systems provide for the hydraulic control of the receiver dish and the cruciform of control fins at the rear. The error-signals from the guidance system are fed into a series of transducers and thence to the hydraulic system which controls the position of each of the four fins. The latter can move together or independently to control the flight of the missile according to the direction of the incoming signal. The missile servos are each compensated in pitch, roll and yaw by gyros which sense disturbance from the original flight-path. As previously stated, the Thunderbird flies a proportional navigational course since this significantly reduces the maximum lateral acceleration.

Finally, the warhead system is detonated by a proximity fuze which senses when the target is within range. Alternatively, of course, the warhead is detonated by impact.

BUCCANEER FROM BROUGH: THE BLACKBURN NA.39

Features of the world's most advanced carrier-borne strike aircraft, the de Havilland Gyron Junior-powered Blackburn NA.39, are seen to particular advantage in this new "Flight" photograph. Note especially the rotating bomb-door with a large dielectric panel to the rear of it (suggestive of Doppler); the fully retractable arrester hook; and the air brake in the extreme tail

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

The Closure of Blackbushe

I WOULD like to endorse the remarks re the forecast closure of Blackbushe made by John D. R. Rawlings, in his letter in your issue of September 4, entitled "Blackbushe and Gatwick."

It is interesting, or perhaps frightening, to enlarge on the construction work that has been completed at Blackbushe during the last eighteen months at a cost to the taxpayer of over £50,000, most of which was spent on facilities that would indicate the extended life of an airport rather than its closure. The terminal building was enlarged to take twice the number of passengers, and the adjacent offices extended to accommodate extra staff. The entrance to the airport, which is situated on the busy A30 road, was re-designed and a roundabout built, and with it a huge car park.

Air Traffic Control, of wartime origin, was completely re-built internally, and as will be seen from a photograph which I enclose, a costly new cupola constructed on the roof. This complies with modern standards, provides an unrestricted view of the airfield and is fitted with modern control equipment. A complete new runway and approach lighting system was installed, and this, combined with the already installed I.L.S., plus the U.S. Navy-operated G.C.A. unit, provides the finest landing aids one could wish for on runway 26/08, 2,000 yd in length and able to take all but the larger types such as Boeing 707 and Douglas DC-8.

Since the closure of Hendon the U.S. Navy have been a lodger unit at Blackbushe, and it was rumoured that the huge hangar, dispersals and compound on the north side cost the U.S. Navy budget 3,000,000 dollars.

Not two miles east of the airport the M.T.C.A. are busy developing the A30 to modern transport standards, and it is quite evident that Blackbushe airport would in some way impede the development. Perhaps the department of the M.T.C.A. responsible for airports has given way to the highways department. If this is so, surely the south side of the airport could quite easily be closed and transferred to the still spacious north side. Are we to lose this airport which can accommodate the non-scheds, executive types, the private flyer with or without radio, plus all who need customs facilities inbound or outbound from the U.K.?

Hemel Hempstead, Herts. NATIVE SON.

"It Isn't Done, Sir"

THE Sydney *Daily Telegraph* recently carried an article, by their aviation writer Harold Droietsky, on Farnborough. He described the Show as a swan-song of British civil and military air power, a parade of has-beens and too-lates. Did Lord Carrington [High Commissioner for the U.K.] correct this? No. Not one word from any official U.K. source here. Just silence.

Some weeks ago the Director-General of Civil Aviation here made what I consider to be a most damaging reference to the Comet 4. It was stated that "there was no comparison possible between the Boeing and the Comet." The inference was plainly that as Australia bought the Boeing and not the Comet there must be something faulty about the Comet. Was the statement deliberately left unqualified to convey such an impression?

Once again, did we hear immediate attacks and corrections from either the S.B.A.C. representative or Lord Carrington? Dear me, no. Once again silence, deep as a tomb.

Yesterday [September 11] we received a visit from a B.O.A.C. Comet 4 on a proving flight. In today's morning papers, the *Sydney Morning Herald* and the *Daily Telegraph*, there is hardly a word to be seen about it. The *Herald* has a bit about one of the pilots getting married here (great sales stuff this), but no photographs at all, while the *Telegraph* shows a picture of two jet engines on the port side and a bit of the wing. Again an article about the bride and bridegroom-to-be. Not a word about 500 m.p.h. cruising potentialities, smokeless take-offs from existing runways, and so on. These are sore points here, as local authorities on the fringes of Kingsford Smith Airport are howling blue murder over the smoke and dust created by the Boeings.

In an earlier letter to you, Mr. Editor, I deplored the fact that B.O.A.C. saw fit to let Qantas get their Boeings into this area ahead of the Comet. This bad publicity for British civil aviation and British civil aircraft is doubly Britain's fault. Now the Press no longer regards the jets as news. The Boeing was splashed all over the papers here for days after its arrival. But the answer of the Press to the Comet's arrival is—"What, jets? Oh, that's old stuff now. No longer news."

When will British Ministers and British business concerns wake up? Recently we have had two senior British Ministers here on visits. Their radio and TV talks fairly oozed complacency; they seemed to have the idea that Australia would buy British just because she is in the Commonwealth of Nations. In point of fact, American interests are getting more and more of a stranglehold on vital industries here every day, especially newspapers, radio and TV. Despite the fact that Britain invests more here than any other overseas power (80 per cent of overseas investment comes from Britain) she still has not learnt that in the face of American ballyhoo she ought to get rid of decorative but silent representatives and get hold of a few hard-hitting, hustling propagandists who will push for all they are worth.

The present idea is that "We mustn't criticize or correct the Australian Government or the Australian Press or airlines. This cosy "it isn't done, sir" attitude is no doubt put abroad with the best of intentions. But such silence is attributed to weakness. It has led to powerful American-inspired lobbyists in Canberra putting over all sorts of half-baked stories (and downright lies) about British civil aircraft as opposed to the Boeings used by Qantas. Misrepresentation has been bad and lack of British representation worse.

Not one of the British Government representatives, apparently, saw fit to ensure that the Comet's coverage in the Press today was adequate by giving proper information. And, of course, the bright B.O.A.C. publicity boys pick the day after Princess Alexandra's arrival here to race in a Comet to Mascot; so the Press is full of Princess Alexandra and almost empty of Comet.

I am sorry to be so caustic, but really it's way past the time that someone got a little agitated.

Sydney, N.S.W. ROBERT BARKER.

Pioneer Airlines

IN his letter on this subject Mr. L. W. Galer, secretary of S. Instone & Co. Ltd., is off the beam saying Instone operated a regular service between London and Paris from October 13, 1919. They didn't! The firm bought a D.H.4A for establishing regular mail communication between their London and Paris offices as the normal surface mail had become so disorganised they couldn't depend on it. When civil airlines were transferred from Hounslow Heath to Croydon on April 1, 1920, Instone continued this service, but also took passengers on irregular charter service and added a Bristol Tourer, Vickers Vimy Commercial, and B.A.T. Fk.26 to their fleet. And with the Vimy they ran 5s joyrides at week-ends.

It wasn't until after Aircraft Transport and Travel Ltd. closed down at the end of 1920 and the Government were forced to grant a subsidy to keep British airlines alive that Instone began regular scheduled services between London and Paris in the late winter, or early spring of 1921. And the Brussels and Cologne services came very much later. The *real* pioneer airlines were A.T.&T. and Handley Page Transport Ltd. A.T.&T. began on August 25, 1919, and H.P.T. a day or so later.

London, S.W.5 GEOFFREY DORMAN.

A NUMBER of points in Mr. Galer's letter on behalf of S. Instone & Co. (*Flight*, September 11) call for correction in the interests of historical accuracy.

First, he twice refers to Instone Air *Lines* before using the correct title, the Instone Air *Line*. (Incidentally, there was no independent firm of that name until 1921, when S. Instone & Co. created a subsidiary limited company to handle its air transport business). Second, although the Instone company flew its first D.H.4 on company business in October 1919, it was not until the spring of 1920 that it inaugurated a *public* service. Finally, although it was the smallest and shortest-lived, the British Marine Air Navigation Company must be added to Mr. Galer's list of the airlines merged into Imperial Airways.

Leicester. ERIC BIRKHEAD.

FORTHCOMING EVENTS

Sept. 24-25. Aerodrome Owners' Association: Conference, Bristol.
Sept. 24-25. AGARD: Ninth General Assembly, Aachen.
Sept. 26-27. Genoa Aero Club: Rally.
Oct. 4-16. Seventh Anglo-American Aeronautical Conference, New York.
Oct. 6. IATA: Dr. Albert Plesman Memorial Lecture. "Supersonic Flight," by Hall L. Hibbard, at Delft, Netherlands.
Oct. 7. R.Ae.S. Graduates' and Students' Section: "Lunar Probes," by J. E. Allen.
Oct. 9. Helicopter Association: "The Programme of Development Testing for a Helicopter," by T. G. G. Newbery.
Oct. 14. Society of Instrument Technology: "An Automatic Analogue Computer for Missile Homing Investigations."
Oct. 22. R.Ae.S. Astronautics and Guided Flight Section: "Problems of Interplanetary Navigation," by T. R. F. Nonweiler.
Oct. 27. Radar and Electronics Association: "Electronics in Supersonic Flight," by F. W. Page.
Oct. 28. R.Ae.S. Graduates' and Students' Section: "Setting of Aircraft Specification," by R. H. Whitby.
Oct. 30. R.Ae.S.: "Man Powered Aircraft, Theory and Practice," by H. B. Irving, Dr. D. R. Wilkie, T. R. F. Nonweiler and B. S. Shenstone.

R.Ae.S. Branch Fixtures (to Oct. 2): Sept. 29, *Luton*, "Ballistic Missile Design," by E. C. Cornford. Oct. 1, *Isle of Wight*, "Aircraft Accident Investigation," by R. C. Clarke.

Sport and Business

A PRIVATE AIR RALLY for members of the Kelvin Hughes (Barkingside) Engineering Society was held at Stapleford Tawney on September 5. With the co-operation of the Herts and Essex Aero Club and the technical help of its chief flying instructor, Gerry Quinn, nearly 100 members and their friends enjoyed a day of competitions and displays. Bill Leary and his navigator, Susan Radnor, from the company's Basingstoke factory, won the Crompton Cup (a newly presented trophy); and second and third prizes went to Ron Turner and David Gully. Barry Radley of Hunting Aircraft gave a display of crazy flying and aerobatics.

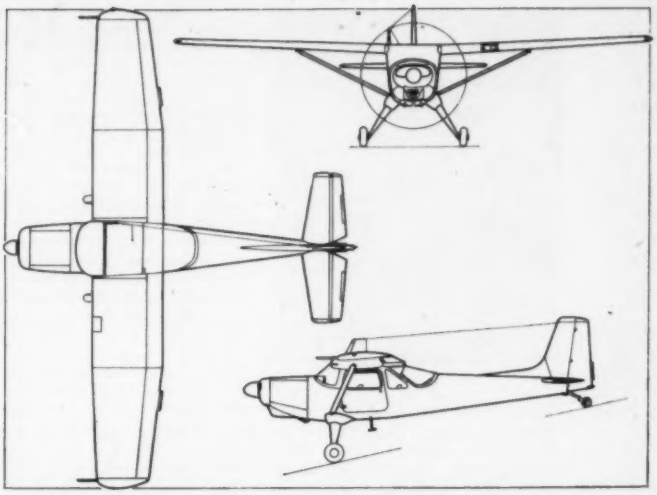
IT HAS BEEN ANNOUNCED by McAlpine Aviation of Luton Airport that they are to supply a Piaggio P.166 to the engineering firm of John Blackwood, Hodge and Co. Ltd., of London, and that they will provide that company with McAlpine's "full advisory service on business flying."

McAlpine's new advisory service to industry, announced only a few days before this particular contract, marks this big civil engineering firm's entry into what it describes as the "fast expanding business flying sector of commercial aviation." Under the direction of Mr. Raymond Young, McAlpine's Aviation Division will advise on such matters as choice of aircraft, operating costs and maintenance, and will lease aircraft at a set fee per hour, giving operators also an option to buy.

McAlpine already own a Piaggio 166 and have been operating their own executive aircraft for nearly 14 years. In the past four years the Aviation Division has almost doubled its activity in terms of annual flying hours. In 1955, using a Rapide and a Gemini, about 380 hr were logged on 530 flights. Last year the firm's Apache and Lockheed 12 flew 533 hr in the course of 951 flights. In the first six months of 1959 about 285 hr were flown in 594 flights by the Piaggio 166.

FORMED TO PROVIDE companies with helicopters and fixed-wing aircraft for executive use, Executair Ltd. started operations recently by providing a Westland Widgeon for use by John Laing and Son Ltd., the civil engineers. Since the middle of June, this aircraft has flown approximately 250 hr, enabling the firm's representatives to visit construction sites in North Warwickshire, Leicestershire and Yorkshire within a single day and giving them about 5 hr conference time out of a 9 hr day. The Widgeon, operated from Laing's sports ground at Boreham Wood and based at Elstree Aerodrome, is much used for visiting sites on the southern section of the London-Yorkshire Motorway. Executair, who say that this is the first time in this country that a helicopter has been chartered for continuous use by a firm of civil engineers, state that they can provide a completely integrated service, for city-to-city or city-to-site travel by helicopter and fixed-wing aircraft, for industrial executives. Types of fixed-wing aircraft available for charter include the Hunting President, Piaggio 166, Cessna 310 and Aero Commander. Executair is an associated company of Film Aviation Services Ltd., of Horley, Surrey.

A SURPRISE at the Paris Air Show was the first public appearance of the Austrian Simmering-Graz-Pauker M.222 Flamingo, a 4/5-seat business aircraft powered by two 150 h.p. Lycoming O-320-A engines. Simmering-Graz-Pauker is a considerable Austrian industrial organization which has recently taken to aircraft production. So far two prototypes have completed several hundred hours' test flying, and delivery of production aircraft is offered in six or seven months. The machine exhibited at Paris was convincingly demonstrated and during one high-speed pass performed an extremely rapid roll in level flight. With variable pitch feathering propellers, the Flamingo offers a single-engine rate of climb of almost 400ft/min at sea level and a single-engine ceiling of 7,300ft. The steel-tube fuselage frame has a metal skin forward and plastic shell aft. A single-piece sliding canopy gives access to both rows of seats, sound-proofing is provided and a baggage compartment situated aft can accommodate a fifth seat. The main units of the nosewheel undercarriage retract hydraulically into the wings and a mechanical standby is provided. The laminar flow, plywood-covered wing is built as a single piece and bolted by its main spar to the fuselage. Two subsidiary spars are not continuous through the fuselage. All fuel is accommodated in tip-tanks incorporating visual content indicators.



The Utva-56, the Jugoslav-designed utility aircraft referred to below

Leading data: Span, 36ft 1in; length, 28ft 10in; wing area, 183 sq ft; gross weight, 3,190 lb; payload, 1,200 lb; wing loading, 20 lb/sq ft; maximum speed, 186 m.p.h.; sea-level cruising speed at 70 per cent power, 167 m.p.h.; initial rate of climb, 1,370 ft/min; service ceiling, 21,000ft; take-off distance to 65ft, 1,740ft; landing run with brakes, 560ft; landing speed, 75 m.p.h.; fuel capacity, 57 Imp. gal; cruising consumption, 13 gal/hr; range at 6,600ft, 800 m.

FOLLOWING A FIRST FLIGHT earlier this year, the Jugoslav Utva-56 utility aircraft is now under test. It was designed at the Fabrika Aviona UTVA at Pancevo by Dipl. Ing. B. Nikolic and Dipl. Ing. D. Petkovic. Powered by a Lycoming GO-435 260 h.p. engine and Hartzell constant-speed propeller, the Utva-56 seats four people, but can alternatively accommodate freight or admit a stretcher through the hinged rear window of the cabin. Normal access doors are on either side. Structure is all-metal, with a braced wing and ailerons which droop to 15 deg when the flaps are lowered to 38 deg. All three undercarriage legs have rubber suspension, with toe-operated hydraulic brakes on the mainwheels and a steerable and lockable tailwheel. Dual control, full instrumentation and an electrical system for lighting and radio are supplied. Spraying or dusting kits are available.

Data: Span, 37ft 5in; length, 27ft 1in; wing area, 194 sq ft; gross weight, 2,823 lb; maximum speed, 161 m.p.h.; cruising speed, 142 m.p.h.; stall, 49 m.p.h.; initial rate of climb, 1,250 ft/min; take-off run, 492ft; landing run, 459ft; range, 434 miles; ceiling, 19,600ft.

RETROSPECT

From "Flight" of September 25, 1909

A 35-mile Flight Reported at Liverpool: It is reported from Liverpool that three practicable monoplanes have been constructed in the neighbourhood, and that on one of them, a flight of about 35 miles has been made. It is said that the trials of these machines have been carried out in secret on a lonely part of the Lancashire coast, north of Liverpool, and . . . in the neighbourhood of West Kirby.

Simmering-Graz-Pauker M.222, described above. Another photograph of this aircraft, taken at the Paris Show, was published in our issue of August 14. The prototype seen at the Paris Show had a particularly smooth wing-finish, conferred by specially doped fabric over the plywood

THE INDUSTRY

The most junior executive ever to be portrayed on a "Flight" industry page is wearing the new R.F.D. infant life-jacket. Intended for the eighteen-month to four-year age-group, it weighs 18 oz and can be inflated orally by a grown-up or, alternatively, automatically (in 1½ sec) by CO_2. It has an automatic light with 20 hours' minimum duration

Additional Duxford Products

THE Duxford, Cambridgeshire, firm of CIBA (A.R.L.) Ltd. have announced two new additions to their range of materials for supersonic aircraft and missile structures. The first, "Aero-web" Type H metal honeycomb, greatly extends the range of operating temperatures for such materials. Whereas, state the company, normal honeycomb core incorporates adhesives showing marked decrease in strength at temperatures over 80 deg C, the new material is bonded with a special adhesive enabling it to be used successfully at temperatures up to 200 deg C.

The second development is the introduction of a new "Hidux" adhesive, 1197, for service at temperatures up to 300 deg C. It is available in two forms, 1197A and 1197B, for metal-to-metal and honeycomb sandwich bonding respectively. For convenience in use both are supplied as films, and storage involves none of the difficulties sometimes associated with high-temperature adhesives.

New Turbine-blade Materials

TWO new 60-ton-tensile stainless steels stated to be especially suitable for rotor and stator blading in gas-turbine compressors, as well as for steam-turbine blading, have been fully developed by Firth-Vickers Stainless Steels Ltd. and are now in regular production.

Identified as FV.566 and FV.520, these two materials have chromium contents in the range 11-16 per cent. They are distinguished from the older martensitic stainless steels by lower carbon (0.03-0.12 per cent) and higher nickel (2-6 per cent) contents. They also carry other alloy additions, viz., 1.5 per cent molybdenum together with vanadium or copper, and niobium.

Compared with earlier steels of this type, say Firth-Vickers, they offer better corrosion resistance with higher yields and tensile strengths; formerly, higher strength frequently meant somewhat reduced corrosion resistance. They also offer better cross-grain ductility, superior impact-strength and greater batch consistency. The difference in properties between the two steels is mainly one of degree. FV.520, which is the more highly alloyed of the two, will withstand more arduous service conditions, having exceptional corrosion resistance equivalent to that of the softer austenitic 18/8 steel. FV.520 is weldable and its high impact-strength suffers no impairment at temperatures as low as minus 80 deg C.

By reason of its mechanical properties and its superior corrosion resistance in salt-laden atmospheres, FV.520 has been chosen for the compressor rotor and stator blading of the C.T.7, the 430 s.h.p. gas-turbine ground-power unit produced by Centrax Ltd. of Newton Abbot. Similar requirements underlie the choice of FV.520 for compressor blading in the Bristol Siddeley Marine Proteus engines used to power the prototype high-speed launch H.M.S. *Brave Borderer*, which recently achieved a speed of over 50 kt during trials in the Channel.

IN BRIEF

Expandite Ltd., of London, N.W.10, have issued a booklet celebrating their 25th anniversary. Among their products is Expandite Aeroelastic for top-sealing runways, standings and factory floors.

Mr. A. N. Haskett, A.R.Ae.S., has been appointed divisional manager of the Aviation Engine Accessories Division of Elliott Bros. (London) Ltd.

Mr. T. G. Munro has been appointed sales manager of Southern Forge Ltd., Langley, Bucks. He joined the sales staff in 1946 and for the two years previous to his present appointment was in charge of publicity and market research.

In collaboration with the M.o.S., the Institute of Aviation Medicine and other authorities, Elliot Equipment Ltd. have added the M.S.20 Mk 2 to their aircraft dinghy range. An important new feature is an inflatable platform to facilitate boarding.

Shell Aviation (St. Helens Court, London, E.C.3) have just published a finely illustrated 32-page brochure on the subject of refuelling of modern civil aircraft. The text, though not of a highly technical nature, is extremely informative and the large half-tone illustrations include a number of photographs of airliners using Shell fuels.

New "Britool" workshop equipment announced by Jenks Brothers Ltd., of Bushbury, Wolverhampton, includes a compression-spring tester for springs of up to 4in free length and 18 lb weight. It gives scale readings (up to 200 lb) in pounds and kilogrammes, and a simple attachment also enables it to be used for the checking of "Britool" torque wrenches.

The Cap Manufacturing Co. Ltd., of Ilford, announce the appointment of Mr. William R. Hardeman, O.B.E., as joint managing director. Mr. Hardeman, who has for four years been a consultant to Dexion Ltd. on products for the aircraft industry, served during the war in the Engineering Branch of the R.A.F., retiring with the rank of wing commander.

The latest company to install Plessey U.H.F. airfield equipment for communication with aircraft being test-flown is the de Havilland Co. Ltd., at Hatfield. The AN/ARC-52 airborne U.H.F. set, which is manufactured under licence from the American Collins Radio Co., is already being fitted in Service aircraft manufactured by de Havilland and a number of other constructors.

Mr. W. R. Booth has been appointed financial director and secretary of the Goodyear Tyre and Rubber Co. (Gt. Britain) Ltd., Wolverhampton. He succeeds Mr. H. A. Brundage, who has returned to the Goodyear headquarters at Akron, Ohio, to take up another appointment. Mr. Booth was managing director of Goodyear-Cuba prior to his move to Wolverhampton.

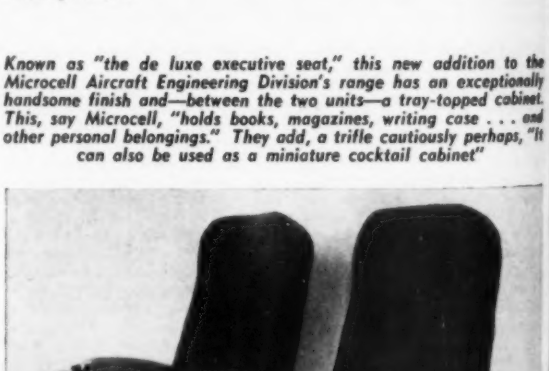
Developed from equipment supplied to M.o.S. order, the Pathfinder air pump cabinet is now available commercially through B.M.B. (Sales) Ltd., of Crawley, Sussex. Fully portable and acting on the refrigeration principle, it gives a continuous supply of air which can be dehydrated to a dew point of −40 deg C (or approaching −50 deg C for special applications) at pressures of 15-60 lb/sq in and flows of up to 20 cu ft/min. The air is clean to 0.5 micron.

Frederick S. Snow & Partners, consulting engineers, are moving on October 12 to their own new office building at Ross House, 144 Southwark Street, London, S.E.1.

BTR Industries Ltd. announce that as from October 1 Mr. P. W. Howard will relinquish the office of managing director but will remain a director and deputy chairman. Dr. W. D. Scott, F.R.I.C., F.I.R.I., has been appointed to succeed Mr. Howard as managing director.

An electroluminescent indicator block produced by Thorn Electrical Industries Ltd. employs 99 rectangular phosphor dots sandwiched between conducting sheets. An A.C. voltage excites the dots to luminescence and by varying the illuminated pattern the indicator can be made to read out any desired character or figure or provide a progress report. The component has a thickness of 0.265in and generates virtually no heat.

Known as "the de luxe executive seat," this new addition to the Microcell Aircraft Engineering Division's range has an exceptionally handsome finish and—between the two units—a tray-topped cabinet. This, say Microcell, "holds books, magazines, writing case . . . and other personal belongings." They add, a trifle cautiously perhaps, "It can also be used as a miniature cocktail cabinet"



An historic moment in Douglas history was recorded on August 31, when the DC-8 was awarded its certificate of airworthiness. Here it is being handed by the Administrator of the F.A.A., Mr. E. R. Quesada (left), to the chairman and founder of Douglas Aircraft Company, Mr. Donald W. Douglas. Scheduled DC-8 services were inaugurated by United between New York and San Francisco on September 18, and on the same day Delta put DC-8s on to its N.Y.-Atlanta route

AIR COMMERCE

RIDDLE'S ARGOSIES

IT was remarked at the S.B.A.C. Display that neither of the two A.W.650 Argosies on show appeared in the markings of Riddle Airlines. One aircraft, G-APRN, was exhibited at the Paris Salon in June in Riddle colours but these had evidently been removed just before the S.B.A.C. Display.

Is Riddle's provisional order for Argosies (*Flight*, February 27) in doubt? This order was signed by Mr. George L. Giles, who joined Riddle as president early in 1958 (and who in the space of 12 months converted it from a sick company to one which—if not yet profitable—is determined to be so).

Last month, reportedly as a result of disagreements over policy, Mr. Giles resigned, and his resignation put the Argosy order in jeopardy. But the acting president, Mr. E. T. Thompson, has signified to Armstrong Whitworth that the provisional order for four Argosies still stands, though the airline has not (according to *Aviation Daily*) yet succeeded in arranging finance. In reply to a C.A.B. request for airline opinion about possible Government-guaranteed loans for the purchase of all-cargo aircraft (see overleaf), Riddle said that, had such a guarantee been available now, the airline would have already entered into a firm Argosy contract for the earliest delivery. To these remarks, made at the end of August, Riddle added that the Argosy would "move it into a profit position."

VISCOUNT STOCKTAKING

AS is inevitable when production of an established product like the Viscount gives way to the Vanguard, some confusion has arisen over the Viscount delivery situation. It is appropriate to record the present position in order to clarify what types of this best-seller can still be delivered and when.

To date, 407 Viscounts of all types have been sold. Of these 404 have been delivered. The balance of three is made up as follows: Pakistan International Airlines, one V.815; Misrair, one V.739; Tennessee Gas Transmission, one V.835 (ex-Cubana). These three aircraft are due to be delivered shortly.

In addition, there are 14 Viscounts in stock or in production. These are not yet allocated to customers, and they are listed as follows: one V.745 (ex-Capital and ex-T.A.A.); two V.744s (ex-Capital); two V.816s (built against a provisional order from T.A.A.); one V.810 (the prototype). All the above are in stock and are available for immediate delivery, with the exception of the 810 prototype which is available for "early" delivery.

In addition, nine V.810s are on the production line at Weybridge, and are available for delivery between now and the early part of 1960. Though there are no V.700s on the production line, new aircraft of this type can be produced for delivery within about 20 months.

The Viscount demonstrated at the S.B.A.C. Display in the colours of T.A.A. was one of the two 816s mentioned above, and was not an 812 as incorrectly reported in our Farnborough Report issue of September 11.

ECONOMY LIP-SERVICE?

BOTH B.O.A.C. and B.E.A. have consistently over the past year declared their intention to advocate the extension of economy-class services, and they have been publicly supported by the Minister. But there is evidence to suggest that their deeds may not be as determined as their words. The evidence is worth considering at this time, when the annual I.A.T.A. fares conference is in session at Honolulu to decide what fares shall be charged during the year beginning April 1, 1960.

A previous note in *Flight* ("Second Thoughts," September 4) suggested that B.E.A. are not as determined as had been generally supposed on extending economy-class service to Europe next year. To recapitulate briefly, the Corporation recently compromised its position before the I.A.T.A. fares-battle at Honolulu by publicly saying that "practical difficulties" facing other airlines will make the implementation of economy fares difficult in 1960. Instead, a more moderate policy of tourist differentials on holiday routes would be pursued.

Can it be that B.E.A. are so satisfied with the way their traffic has recovered and boomed (see "How Grows It?" September 11) that they feel the market will continue to bear the prices at present being charged? Certainly tourist differentials can improve economics by flattening out the costly traffic peaks that characterize B.E.A.'s year. But it is not easy to see how such fares alone can expand traffic exuberantly enough to fill the very big increase in capacity that B.E.A. will have available to schedule next summer.

Next June, when the Corporation is well on the ascent to its summer traffic peak, B.E.A. will have available for service at least four of its seven Comet 4Bs (all of which are due for delivery by the summer). In addition, the Corporation will have at least three Vanguards available for service at this time.

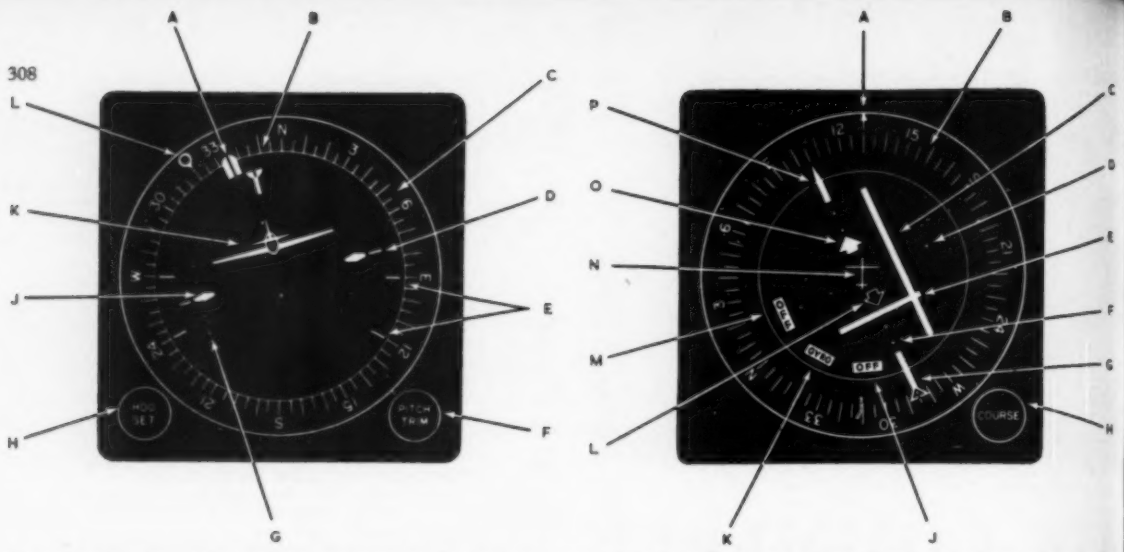
These initial fleets of Comets and Vanguards will be equivalent, in terms of seat-miles per hour, to another fleet of 20 Viscount 700s. Traffic will thus have to expand at a very high rate if all the seats available next summer are to be filled—particularly when account is taken of the fact that all Viscount 700s and 800s are to have increased seating. (Already nine of B.E.A.'s 25 V.700s have seating increased from 47 to 63; about 12 will have been converted by August 1960. Likewise, work will start in April on the conversion of all 21 V.800s from 57 to 66 or, without catering, 72 seats. Of course, many DC-3 services will be taken over by the high-density Viscounts. But it is evident that there will still be an addition of at least 40 per cent to B.E.A.'s trunk-line capacity next summer. Will present fares and promotional discounts alone ensure that all this capacity will be filled at economic load factors?

At first sight B.O.A.C.'s economy-fares policy appears more convincing. Writing in *The Financial Times* Sir Gerard d'Erlanger says: "If we are frustrated at the next I.A.T.A. conference [now meeting at Honolulu] we may well make plans to introduce lower fares wherever we have the right to do so, backed by the British Government, and rights we certainly have, wherever we have some cabotage area. That we have not taken advantage of our favourable position in the past is due in large measure to the fact that we have played fair with I.A.T.A. We cannot, however, stand by and watch potential trade stifled."

Strong words indeed, especially when considered in the light of certain significant evidence given in the recent Parliamentary Select Committee's report. As already noted in *Flight* (August 21), a memorandum from B.O.A.C. (page xxi of the report) reveals that the Corporation considers tourist-class fares to make exactly the right profit; and using these as an index it was shown how other fares would have to be "adjusted" to make them equally profitable. Economy class on the North Atlantic was shown to require a 12 per cent increase—which would put economy fares back (within 15 shillings) to the tourist level prevailing before April 1958. In other words, since sandwiches were banished months ago, economy class would, except for 34in seat pitch, be the old tourist-class by another name.

This evidence in the Select Committee report is 14 months old, and the figure of 12 per cent was presumably theoretical rather than a declaration of intentions. But it prompts doubts as to what B.O.A.C. mean by the "economy class" service that they propose to extend to Commonwealth routes. A reasonable definition of economy class would be a service priced at about 15 per cent below *existing* tourist levels, with reduced frills. It may well be that B.O.A.C. are indeed proposing such economy fares for the Commonwealth routes. Certainly an economy fare of anything less than 10 per cent below existing tourist levels would be a disillusioning devaluation of the word economy—particularly when considered in the light of the independent "V.I.F." proposals for British cabotage routes, which average 48 per cent below existing tourist levels.

J. M. R.



The two instruments which form the monitoring or director components of Lear's LIFE. In the attitude display on the left the silhouette which moves in a "drone" or "outside-in" presentation, shows the aircraft in a climb banking to the left to make good the rate of turn required by the bank command index to reach the heading shown by the heading index. At right, in a different situation, the aircraft is closing a radio course of 105 deg from the left on a heading of 130 deg. The course is inbound and the "To" arrow is showing. The key at the foot of this page lists the various indicators

AIR COMMERCE . . .

LIFE IN ENGLAND

AS part of a European tour, William P. Lear, president of Lear Inc., demonstrated his firm's Integrated Flight Equipment instruments and L-5 autopilot in a Beech D18S registered N34L at Hatfield last week. His intention was to demonstrate to Government and airline officials how simple and natural the integrated instrument arrangement of LIFE can be both for normal airline operations and for pilots with a minimum of instrument experience. Secondly, Mr. Lear was demonstrating that the L-5 autopilot, which forms part of the complete LIFE system, could accurately and steadily keep an aircraft in the very centre of a normal I.L.S. beam so that coupled autopilot approaches could safely and regularly be made down to 20ft. It was, he said, quite feasible to establish operating minima of 100ft ceiling and ¼-mile visibility. Thirdly, Mr. Lear announced that his company was preparing a radar altimeter-operated flare-out system and a triplex autopilot which would permit automatic landing without the use of leader cable for final track guidance. The demonstration was given in conjunction with Pye Telecommunications Ltd., whose I.L.S. is installed at Hatfield and which, Mr. Lear said, was the best he had yet seen.

Flight's representative made a manual I.L.S. approach using the integrated instruments, which are distinctive because the miniature aircraft silhouette moves to indicate change of attitude and a rotating compass scale is mounted in the attitude display. A command index is displaced to left or right relative to the standard bank pointer at the top of the dial to direct left or right turns for following selected headings, V.O.R. radials, or I.L.S. localizers. Pitch instructions for height holding or glide-slope following are in the form of miniature "tip tanks" either side of the aircraft silhouette. A horizontal situation display incorporates a course displacement needle moving laterally relative to a selected course index which is positioned against the rotating compass scale. A glide-slope pointer is also included in this dial.

U.S.A.F. and Lear tests have shown that an average of 5.7 min is needed for a pilot used to the traditional attitude presentation (fixed silhouette and moving horizon bar) to accustom himself to the "outside-in" or "drone" presentation used in LIFE. It has also been shown that a pilot without any previous instrument experience can be taught in about an hour to put up a creditable performance in turns, climbs and descents using LIFE. The writer found it immediately natural, noticing only that the opposite movement of the bank indicator and compass dial as a turn was initiated gave a momentary impression of an excessive rate of bank. During the manual I.L.S. approach in a strange type of aircraft, there was remarkably little difficulty in following the directions, but long habit of regarding the silhouette as a fixed element led at one point to opposite-sense reaction to glide-slope indications. Without any great familiarity with I.L.S. flying, the writer managed to reach a point about 20 yd to one side of the runway at about 50ft without looking out of the cockpit after the outer-marker stage.

The L-5 autopilot, which won Lear the Collyer Trophy some years ago, is fitted in F-86D, F-84F, B-57, KC-135 and, in a transistorized version, in Caravelles. It is distinctive in that it avoids hunting by providing low displacement signals but continual integration of path signals to produce very close long-term control. In the Caravelle version the integration time-constant is altered according to the number of error-signals, providing a built-in non-linearity. In a DC-6, flown at nine per cent forward and 33 per cent aft c.g., maximum hard-over signals never produced more than 0.55g. It is claimed that Piedmont Airlines' F-27s, fitted with LIFE, have the highest scheduled regularity in the U.S.A. despite average 80-mile stages and eight landings per aircraft per day. The LIFE system has contributed greatly to achieving this regularity in an area where weather is generally poor. Both Air France and S.A.S. Caravelle crews have now applied for a lowering of approach minima on similar grounds, and Mr. Lear himself has landed his Beechcraft in obscured conditions with visibility less than ⅛-mile when he subsequently had difficulty in locating the taxiway.

In the Beech D18 at Hatfield, Lear test pilot Bill Darling showed that LIFE could in fact achieve a smooth and accurate automatic approach to a height of about 20ft where the pilot took over for a manual touch-down. The equipment produced the required result despite rough air and a cross-wind.

Looking further ahead, the whole question of automatic landing is at the moment bedevilled by actual installed performance of I.L.S. Pye state that the 50 or so installations they have provided for civil use all over the world have a localizer which is continuously corrected by the monitor so that azimuth accuracy at the touch-down end of the runway is within a matter of feet and certainly well within I.C.A.O. specifications. What will have to be determined and, if necessary, corrected with other I.L.S. equipment is the precise effect on automatic landing operations of site errors and transient deviations caused, for example, by the presence of other aircraft flying in the vicinity. Certain it is that many, if not the majority, of I.L.S. installations are at present unsuitable for automatic landing; and in some sites there seems to be little chance that an I.L.S. will ever be able to provide the necessary guidance. The sites at Hatfield and Bedford are favourable, that at Geneva extremely difficult and at Rome/Ciampino impossible. Clearly a great deal remains to be done before automatic landing, established as a thoroughly workable method by B.L.E.U., emerges as thoroughly usable airline hardware.

KEY

Attitude indicator, top left: A, computer bank-command index; B, aircraft bank index; C, rotatable compass scale; D, level pitch references; E, roll reference marks; F, pitch trim knob; G, glide-slope reference dots; H, heading selecter knob; J, computer pitch-command "tip-tanks"; K, moving aircraft silhouette; L, desired heading index (set from H).

Horizontal situation display, top right: A, fixed lubber line; B, rotating compass scale; C, course displacement dial; D, course deviation dots; E, glide-slope pointer; F, glide-slope deviation dots; G, reciprocal course index; H, knob to set P; J, LOC/VOR warning flag; K, gyro warning flag; L, "From" arrow; M, glide-slope warning flag; N, fixed aircraft reference; O, "To" arrow; P, course index.

Still Around the Corner

AN article in these columns on August 28 reviewed the resurgence of optimism about the future of all-freighting. Events of the past few weeks appear to call for some tempering of this optimism. Recently Riddle's provisional order for Argosies was put in doubt by the resignation of the president, Mr. George L. Giles (though the airline has said that the order is still alive). It seems also that the contracts placed by Pan American and Slick for, respectively, 12 and six Lockheed GL-207 Super Hercules may not materialize.

A condition of these GL-207 orders was that they could become invalid if, by September 30, the U.S. Government did not order a fleet of the military version for M.A.T.S. It is now clear that the U.S. Defense Department budget for 1960 does not provide funds for the purchase of these aircraft, and it thus appears that Slick and Pan American are now able to withdraw from the contracts.

A further cautionary note about the future of all-cargo has been struck. In August, the American Civil Aeronautics Board proposed that the Government should guarantee U.S. airline financing of a new turbine-powered all-cargo aircraft. The idea behind this proposal was to break the vicious circle of "no mass air freight market, no 4d/ton-mile freighter, etc." The C.A.B. has been concerned about the still elusive breakthrough in air freight, and about the need for the airlines to modernize their all-cargo fleets. And the Board recalls the success of the system of Government-guaranteed loans that permitted U.S. local service carriers to finance their F-27 programmes two years ago. But the latest C.A.B. proposals have met with an almost universally cool response, at any rate among the big U.S. "trunkline" carriers.

American Airlines, Eastern Air Lines, T.W.A. and United all feel that a Government-guaranteed loan programme is not justified. A summing up of the individual reactions suggests that the collective reason is threefold: (1) The right sort of aircraft is not yet available. Mr. C. R. Smith of American says: "We are talking about financing a plane that cannot be complete until a suitable powerplant is ready." This was no doubt a reference to the Lockheed GL-207 Super Hercules powered by Allison T61 turboprops. (2) There will, the airlines feel, be no difficulty in arranging private financing when investors can be shown that a suitable all-cargo aeroplane *is* available. (3) The airlines have such an excess of cargo capacity already in the form of piston equipment and the cargo holds of new jet equipment.

The smaller all-cargo carriers do, however, feel that the proposed loan programme is needed—though it is interesting that Flying Tiger (which has bought ten Canadair CL-44Ds) "wants none of it." This airline and Seaboard are the only carriers in the world, all-cargo or passenger, to have placed firm orders for new turbine-powered all-cargo aircraft—CL-44Ds in each case. The future of mass air freighting still seems very much around the corner.

Meanwhile Boeing and Douglas are offering cargo versions of their big jets. Boeing say that the model 735, a swing-tail turbofan (JT3D) cargo version of the 707, can be put into production with an order for less than ten aircraft, the first being available during the first quarter of 1961 at a cost of £1.95 million to £2.15 million. Gross weight would be 316,000 lb, cargo volume 9,000 cu ft, and capacity payload 100,000 lb. Powerplant would be JT3D turbofans. And Douglas is actually building a prototype all-cargo version of the DC-8 to be completed next year. Like Boeing's model 735, it will be powered by JT3D turbofans and it will of course have a swing tail. Price would range from £1.5 million to £2.15 million, and Douglas expect sales to carry the DC-8 programme beyond its break even point.

Footnote: The suitability of the Canadair CL-44D for all-cargo work was outlined recently by the president of Flying Tiger, Mr. Robert Prescott. Speaking in Los Angeles earlier this month he forecast 1961 American air freight tariffs averaging 11½d/ton-mile, with certain rates as low as 5d. The CL-44D would, he explained, have a *fixed* cost (depreciation, insurance, tax) of £900 per day. At a utilization of ten hours per day this would be equivalent to £90 per hour. But if utilization could be made to reach 16 hours per day, fixed costs would come down to £55 per hour—a saving in operating cost per aircraft amounting to about £215,000 per year. Mr. Prescott reckoned that this kind of improvement could be brought about by the CL-44D principally by the time that it could save in loading and unloading through the swing tail, and in reduced engine maintenance.

B.E.A. AND OLYMPIC

"THE biggest commercial and operational deal we have yet done in B.E.A.," is the way Mr. J. W. G. James, flight operations director of B.E.A., describes the recent "consortium partnership agreement" with Olympic Airways. Writing in the Corporation's flying staff magazine *Intercom*, he describes the new "Consortium Partnership" as going beyond the previous pool agreement. It is B.E.A.'s intention, he writes, to effect the greatest economy by combining the operations of the two fleets. These will consist of four B.E.A. Comet 4Bs and two Olympic Comet 4Bs; in addition Olympic will have three DC-6Bs and B.E.A. will have Viscounts, so giving approximate equality of flying hours between the partners.

It is intended, Mr. James goes on, that the Olympic Comets will be maintained by B.E.A. and operated by Olympic crews trained by B.E.A. The Corporation's own Comets would, of course, be operated by B.E.A. crews. The Comets are to be technically identical in everything but their insignia and as there can be only one standby aircraft at London Airport it is possible on some occasions that an Olympic crew would be operating one of their own services in a B.E.A. aircraft and vice versa. In such cases the appropriate operator's markings "would appear to the greatest extent possible." Mr. James emphasizes that the separate identity of the services will be maintained.

The Consortium route network, notes Mr. James, will lie along the axis London - Athens with extensions to various points in the Eastern Mediterranean area. The strategy is for a B.E.A. Comet from London, and an Olympic Comet from Paris and various other Viscount and DC-6B services through other European points—all on a daily basis—to meet in Athens and fan out to various points to the east of Athens on the Mediterranean seaboard—Nicosia, Istanbul, etc. This will, he says, give the Consortium a great variety of interchange and interline opportunities through the junction at Athens.

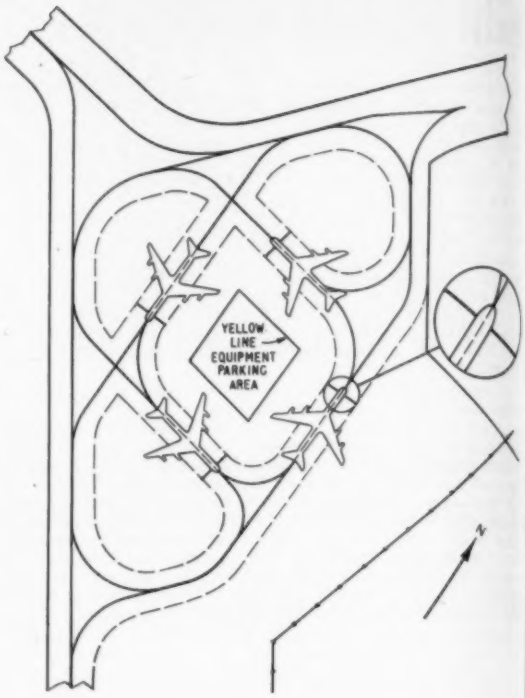
Noting that it is "absolutely essential to fill every possible seat in our own and Olympic's aircraft," he quotes B.E.A.'s commercial department as saying that a 30 per cent increase in revenue must be achieved over the routes concerned.

QANTAS NEED THE COMET

WHEN Qantas and B.O.A.C. announced on September 1 their eight-times weekly Boeing 707 and Comet 4 jet services on the London - Sydney route, it was said: "A ninth service per week will be operated by a Comet from London and a Super Constellation from Australia connecting at Singapore." The significance of this came to light last week when it became known that Qantas, who have always regarded the Comet as unsuitable, will charter a Comet 4 from B.O.A.C.

It appears that the Comet is needed by Qantas to maintain their share of the Kangaroo pool on the routing to Singapore via Athens, Teheran, Karachi, Colombo and Kuala Lumpur, because Colombo and K.L. are too small for the 707. The first Qantas Comet service will depart from London on November 7, and the operation will be a straightforward "voyage charter" with the aircraft crewed by B.O.A.C. flight and cabin staff. There will be some Qantas identification on the aircraft: the nature of this is not yet clear, but it is unlikely that an aircraft will be completely repainted.

Here in Canadair's Montreal plant are the first swing-tail CL-44Ds approaching the flight test stage. The aircraft in the background has its Rolls-Royce Tynes and D.H. propellers installed; its first flight is scheduled for early November. The article above reviews the latest prospects for the air-freight business



Soon to be operational at London Airport, near the proposed site of the new long-haul building, is this experimental "diamond" apron layout. It is expected to permit big jets to manœuvre under their own power without the need for blast screens. Markings and notice boards should dispense with marshallers and taxy routes should avoid the jet blasting of other aircraft. A permanent scheme with passenger access to the terminal in the middle was described in "Flight" for Nov. 7, 1958

AIR COMMERCE . . .

SABENA-CONGO AND AIR UNION

ONE of the most difficult problems attending the birth of Air Union was the incorporation of Colonial air services in the proposed consortium. Since Britain's Commonwealth interests are often cited as one of the reasons why closer collaboration with Europe is not possible, it is important to consider how Sabena have solved the problem of reconciling with Air Union their interests in the Belgian Congo—a colonial territory which is heading for political independence.

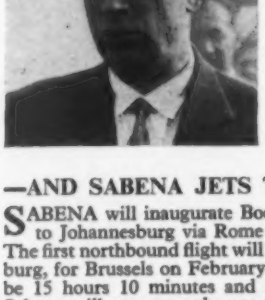
Air Union will take over all Sabena's international routes, including that to the Belgian Congo. However, the internal Congo network (Sabena-Congo) will become economically detached from these operations. Sabena have had to re-define their policies in the Congo; and the director-general, Mr. W. Deswarte, has explained this re-definition.

The principal task of Sabena-Congo will continue to be the "supervision of management and economy." Local management "will retain wide powers of interpretation and adaptation of instructions to local conditions," and Europeans will continue to be counted upon for the high professional standards so essential in the airline business. However, a nucleus of African personnel has been recruited to be trained "progressively to take over positions of the highest responsibility." Sabena has already appointed an African as head of an important part of its Congo network (Buhaun District), incidentally becoming the first large Belgian company in the Congo to include a native in its central administration.

It is emphasized that Air Union "in no way implies a reduction in the powers which Sabena exercises over its Congo affairs."

The facilities which Sabena-Congo will supply to Air Union services to the Belgian Congo, terminating or transit, will be charged to Air Union, which for accounting purposes will appear as a customer. Obviously, since the route to the Belgian Congo will be absorbed within Air Union, local timetables and some routings will be affected, and the domestic network will therefore have to be re-arranged to provide the desirable connections. These changes will coincide with the replacement of DC-3s by Convair 440s.

Sabena appear confident that, even if the political destinies of Belgium and the Congo diverge, the economy of the Congo will always remain principally centred on Belgium.



Recently appointed head of Aeroflot is General E. F. Loginov, seen here on his way through London by Tu-104 to New York last week. He succeeds Marshal P. F. Zhigarev, who has retired. General Loginov's title is Chief of Head Administration of Civil Aviation of the U.S.S.R.

—AND SABENA JETS TO AFRICA

SABENA will inaugurate Boeing 707-320 flights from Brussels to Johannesburg via Rome and Leopoldville on February 15. The first northbound flight will leave Jan Smuts Airport, Johannesburg, for Brussels on February 17. Elapsed time for the trip will be 15 hours 10 minutes and flying time 12 hours 40 minutes. Sabena will operate only one frequency a week, compared with its present two DC-7C services between Brussels and Johannesburg via Leopoldville.

B.O.A.C. will beat Sabena to the inauguration of jet services to South Africa by nearly three months; Comet 4 services are due to begin on December 2. There will be four Comet frequencies a week, the fastest flight taking 17½ hours elapsed time, cutting five hours off the Britannia schedule. The Comet (with 20 first-class and 43 tourist seats) will call at Rome, Khartoum, Nairobi and Salisbury (Salisbury being dropped on the fastest schedule).

HYMANS ON AIR UNION

WRITING in *The Financial Times Survey of Aviation*, the president of Air France, M. Max Hymans, reviews the aims and objectives of Air Union, the European airline alliance of Air France, Lufthansa, Alitalia and Sabena that is due to become operational on April 1, 1960.

His is the first article to be written for the British Press by a leading figure in a consortium which, in the view of some people in this country, poses a formidable challenge to Britain's future share of international air transport. M. Hymans first explains the background to Air Union as follows:

"Operating costs and investments are rising to enormously high figures. New aircraft, new runways, new hangars, new maintenance facilities need more money; and since it seems to be a tradition in air transport that the profit will be small, it is clear that more economic operation is essential. And a large number of national carriers operating in competition with one another have to maintain a great many separate technical and operational units which ultimately results in a system of multiplying, unnecessary expenses which airlines can no longer afford."

Air France's president then anticipates, and dismisses, fears that Air Union will become a cartel:

"Among the public, here in Europe and even overseas in the New World, there clings a widespread fear that co-operation ends in a cartel, in the Malthusian sense of the word. This would, of course, be a dead end.

"We need competition. It is an obvious incentive for the airlines themselves and it will always mean better service for the public. Some misled people actually confuse competition with what is only misused or misunderstood liberty. Liberty is the right to choose what is good, what is useful, what is efficient, not what brings disorder to the community. We now have competition to such an extent that we wonder whether it still *is* competition. Too much of it leads either to confusion or to monopoly, and no airline in Europe is big enough to want a monopolistic situation. We stand for sound and healthy competition, such as we see in the United States working smoothly under the supervision of the Civil Aeronautics Board."

M. Hymans goes on to stress that existing agreements—for instance, the Air France pool with B.E.A.—will not be affected by Air Union. And Air Union will "not in the least be a closed shop; when we launch Air Union it will be with the strong hope that other airlines will join us, as several have already considered doing."

Nobody, he writes, would use a bulldozer to plough his garden or a penknife to cut down a forest. Expansion in air transport, too, "needs the right tool." This tool is co-operation. "We have

an old saying, 'L'Union fait la force.' This can be Air Union's motto; and it would not be an aggressive one."

Concluding, Mr. Hymans makes what seems to be an oblique reference to Britain's decision to remain "out":—

"Either European airlines will be able to co-operate and expand, or they will shrink to the stage of local airlines, feeders for extra-European carriers. When I say European, I do not mean Continental, but use the word in its genuine geographical meaning. The issue at stake is the prosperity of European air transport or its gradual decline."

SIR GERARD ON THE COMMONWEALTH

IN the same publication the chairman of B.O.A.C., Sir Gerard d'Erlanger, refers to the idea of a "Commonwealth Air Union," the background to which was reviewed in an article in last week's *Flight*.

"B.O.A.C.'s basic interests are mainly with their Commonwealth partners and associates," he writes, "with whom we already operate in pool and with whom we are in the process of negotiating even closer ties in respect of routes and services, spares and equipment."

Sir Gerard does not actually say that though pools exist with Qantas and S.A.A. they are still being negotiated with Air-India and T.C.A.; but he considers that "a time may well come when B.O.A.C. and the airlines of the Commonwealth, with which we have or are considering agreements, will be operating standardized equipment and dictating jointly the type of aircraft and aids that they need to ensure safe, efficient and economic operations on their routes."

Any thoughts of an arrangement such as S.A.S. have with Swissair appear to Sir Gerard to be "a little distant," so diverse is the equipment used by the Commonwealth airlines. He does not note that B.O.A.C., Air-India, Qantas and S.A.A. have all ordered 707s, and that B.O.A.C., Air-India and T.C.A. have all ordered Rolls-Royce Conways. But he considers that a Commonwealth version of Air Union may eventually come into being.

TWIN-ENGINED DC-9

THE case for a twin-engined short-range jet airliner, put forward in these columns on March 6, is now being tried out on airlines interested in the DC-9. It is reported by *Aviation Week* that Douglas are offering a twin-engined version of the DC-9 powered by two Pratt & Whitney JT3D turbofans of 17,000 lb thrust each. These will be mounted in underwing pods and not on the rear fuselage "because of [Douglas'] long experience with wing pods and because they believe centre of gravity becomes a very critical item in rear mounted engines and can prevent a switch to heavier engines."

The DC-9 about which figures have so far been released is powered by four Pratt & Whitney JT10A turbofans of 8,250 lb thrust each—a total of 33,000 lb compared with 34,000 lb for the proposed twin-engined version.

707 TRAINING LIMITATION

AS a result of the accident to an American Airlines Boeing 707 which crashed at Calverton, Long Island, during a training flight on August 15, the American Federal Aviation Agency has ordered "two-engine-out" landing approaches to be made at altitude. The altitude is not specified, but is understood to be not less than 5,000ft.

Though the C.A.B. inquiry into this accident is not yet complete, evidence suggests that the aircraft was approaching to land with the two starboard engines throttled back when it began a right turn. This became progressively steeper until the aircraft hit the ground.

Boeing and American Airlines pilots have said that they considered the two-engine-out training manœuvre desirable, and that they feel no apprehension about it.

BREVITIES

A new terminal building is to be opened on October 24 at Punta Caucedo Airport, Dominican Republic.

As from October 25 B.O.A.C. will operate four weekly Britannia flights from London to Chicago compared with three last winter. Two flights will be via Shannon and two via Glasgow.

S.A.S. have ordered from Redifon a simulator for training crews in the operating techniques necessary for the Pratt and Whitney JT4 engines of the DC-8. It will be installed early next year at the S.A.S. mechanics' school at Arlanda Airport, Stockholm.

It is reported that the Indian Government is negotiating with Union of Burma Airways for the three Viscount 761s operated by U.B.A. The transaction is stated to be valued, with spares, at Rs.3.3m (about £250,000).

Mr. M. M. V. Custance, deputy secretary at the M.T.C.A., represented the U.K. at a meeting of delegates from 19 West European civil aviation authorities that opened in Bonn on September 16. The agenda included the improvement of airports, European co-operation in air traffic control, and forward planning for supersonic air transport.

Business settled by the I.A.T.A. Clearing House in London during the first six months of 1959 was up 24 per cent compared with the same period in 1958. The total cleared was £159,670,000. One airline's turnover was settled by the single payment of £1, representing an "offset ratio" which, say I.A.T.A., is "the nearest approach to infinity the Clearing House has ever had." The number of accounts settled at the end of June amounted to 97.

The new airport at Wellington will be opened on October 24. The largest air display ever staged in New Zealand will take place, including three R.A.F. Vulcans, a Comet, a Beverley and a Britannia; three R.A.A.F. Canberras; R.N.Z.A.F. Canberras; U.S.A.F. fighters and transports; and civil aircraft including the Handley Page Dart Herald, T.E.A.L.'s Electra, N.A.C.'s Viscounts and, it is hoped, the Fokker Friendship.

A claim for damages amounting to about £90,000 has been filed in New York against K.L.M. on behalf of an American passenger who lost his life, with all 98 others on board, when K.L.M's Super Constellation PH-LKM crashed 130 miles off the coast of Ireland en route for New York on August 14, 1958. The claim, according to Reuter, accuses K.L.M. of "negligence in overloading the aircraft, and failure to repair an alleged defective and dangerous condition."

The 93rd and latest airline to become a member of Aircraft Exchange is Maritime Central Airways.

The latest zero fuel and maximum landing weights for the Fokker Friendship are both 35,700 lb; maximum weight is 37,500 lb and not 35,700 lb as stated in our September 4 issue.

A scheduled service between Luton, Exeter and Newquay, to be operated during the 1960 summer season, has been applied for by Derby Aviation.

It is now certain that Iberia have confirmed a previously reported provisional order for three DC-8s. No further details are as yet available, except that JT3D turbofan engines are specified.

It is reported that T.W.A. have sold ten Martin 4-0-4s, five Martin 2-0-2s, five DC-4s and one L.1049 for about £1.05 million to California Airmotive Sales Corporation, which has an option on a further 27 T.W.A. piston aircraft worth about £2.5 million.

Though the value of Transcontinental's recent order for two Britannia 305s has not been officially disclosed, it is reported that the Argentine Industrial Bank is to guarantee up to half a sum of £2.36m at 5½ per cent annual interest, and that the purchase is being financed by Bristol over a five-year period.

It is reported from Wellington that a decision is expected shortly on the DC-3 replacement that N.Z.N.A.C. are to order. The airline has recommended to the Minister of Civil Aviation that four Fokker Friendships should be purchased. A further order for seven or eight would be placed at a later date.

A new section of *Packaging Code*, published by the British Standards Institution, has been prepared "largely at the request of the airlines." The new section is entitled *Packaging For Airfreight* and it gives guidance which "should greatly assist packers in avoiding wasted time and energy." Copies may be obtained, price 4s 6d, from B.S.I., Sales Branch, 2 Park Street, London, W.1.

James Burness have been appointed as sole brokers on the Baltic Exchange for Ariana Afghan Airlines, who have DC-4s and DC-3s available for charter. Ariana, which operates scheduled services from Kabul to the U.S.S.R., China, India, Pakistan and Persia, is associated with Pan American. The airline is said to be "particularly interested" in passenger and freight business in the Far and Middle East and European areas.

This is an impression of the terminal of the new Rome international airport now being constructed at Fiumicino. It is scheduled to be in operation by June next year as a replacement for the airport at Ciampino

SERVICE AVIATION

Battle of Britain Week

A SERVICE of Thanksgiving in Westminster Abbey last Sunday afternoon followed by a fly-past led for the last time by a Spitfire and Hurricane (the former subsequently having to force-land near Bromley, owing to engine failure), brought to a close the events marking this year's Battle of Britain Week. It had begun with a service on the previous Sunday at the R.A.F.'s central church, St. Clement Danes; then on September 15 a wreath was laid on the Air Forces memorial on the Victoria Embankment by Lord Dowding, A.O.C-in-C. Fighter Command in 1940, on behalf of the Battle of Britain Association: and immediately after the ceremony a lone Spitfire flew overhead in salute.

Throughout the week R.A.F. exhibitions were held in the Air Ministry building in Whitehall and on Horse Guards Parade, showing how the Battle of Britain was directed from Fighter Command headquarters and illustrating current Service activities. The Vickers Supermarine S.6B which in 1931 became the first aircraft to exceed 400 m.p.h. was displayed, as were past and present types of Service aircraft: a Spitfire, a Hurricane, Jet Provost, Sycamore, Hunter and a section of a Comet 2.

Last Saturday the public at large was enabled to see the Royal Air Force at first hand, when thirty-one stations were "at home" and about a million visitors went to watch static and flying displays, the latter given not only by R.A.F. but also by U.S.A.F. and Fleet Air Arm aircraft. This year, for the first time, lavish souvenir programmes were produced on a national scale: all proceeds from these booklets (which carried local insets) go to the R.A.F. Benevolent Fund and Royal Air Forces Association; and extra copies are available, for anyone wishing to purchase them, from the stations concerned.

At Cottesmore in Rutland, a V-bomber base commanded by one of the most famous Battle of Britain pilots, G/C. J. E. Johnson, the afternoon's programme was opened by his fellow "ace" G/C. Douglas Bader; and the flying display was so arranged as to give a perspective view of famous aircraft in service from the First World War onwards. Thus the 46,300 people who attended this well-organized "at home" saw a Bristol Fighter and S.E.5A (the one recently reconstructed at Farnborough); an Avro 504K and Tutor; Gloster Gladiator; Spitfire and Hurricane; and three Lincolns, a notable formation commemorating the last of the R.A.F.'s piston-engined bombers. Current Bomber and Fighter Command types were represented: Hunters (both a five-man team from No. 111 Sqn., led by F/L. Brian Mercer, and a single Hunter from No. 65 Sqn.), Javelins and a Swift; Canberras; and the three V-bombers, with Victors of the resident squadrons (Nos. 10 and XV) landing at intervals during the display. A notable addition to the programme was the appearance of a Lightning, soon to enter R.A.F. service, flown by S/L. J. M. Nicholls. It was also shown off at Biggin Hill, Gaydon and Syerston. Training machines were represented by both Jet and piston-engined Provosts, a Chipmunk and Vampires; and an Argosy, 20 of which are on order for the R.A.F., was displayed by the A.W.A. chief test pilot, Mr. Eric Franklin. The Royal Navy showed one of its latest fighters, a Scimitar; and the U.S.A.F. the B-66 and F-100. There were civilian contributions too: an Olympia glider, Comper Swift, Bishop Tiger and B.E.A. Whirlwind all giving weight, with numerous static displays, to a satisfying afternoon's entertainment. The weather was overcast and some impressive shock-waves were produced, notably by the Swift and Scimitar.

Gaydon's "at home" attracted a crowd estimated at 115,000—5,000 more than last year but well below the 200,000 anticipated. One of the highlights of the flying display, an attempt on the delayed parachute drop record by the Skydivers team, was put off until the last moment in the hope that cloud would clear for the planned 14,500ft descent. The drop eventually had to be made from a less spectacular height of 5,000ft.

As was to be expected on a V-bomber station, Valiants, Vulcans and Victors provided the "meat" of the programme. There was stern competition, however, from aircraft which have long had their day. A dog-fight between a Spitfire and a Hurricane, for example, riveted the attention of thousands who had grown rather blasé about the thunderous roars of V-bombers, Hunters, Javelins, and other jet aircraft.

A flying display of about 50 items filled the time between 2 and 5 p.m., without an untoward incident to mar the smooth running of the show—except for a collision between the wing tip of a Coventry Gliding Club aircraft and a Tannoy speaker. The latter was badly bent and the glider lost a section of its wing though it managed to touch down safely.

Over 18,000 people visited the "at home" at R.A.F. Valley, Anglesey, where thin cloud at 4,000ft formed a backcloth for the 2½-hour flying display. The aircraft taking part included the station's own Vampire aerobatic team, quartettes of Hunters, Meteors, Javelins and Sea-hawks, a pair of Provosts and examples of ten other types of aircraft from a Chipmunk to a Vulcan. Ground displays included a Thunderbird missile and a demonstration of the loading of a Firestreak under the wings of a Javelin.

At R.A.F. Chivenor, Devon, two Naval airmen were killed and two injured when two Sea Venoms from R.N.A.S. Yeovilton collided in mid-air during the flying display. But apart from this accident, no untoward incidents were reported from the thirty-one "at home" stations, in demonstrations involving a total of about 750 aircraft.

This view of H.M.S. "Victorious," taken last week from the carrier's plane-guard helicopter, shows her steam catapults and angled deck and the aerials of her Type 984 radar. She carries three squadrons, Nos. 803 (Scimitars), 831 and 893 (Sea Venoms), a flight of Skyraiders (849B) and an A.S.R. flight (Dragonflies)
"Flight" photograph

IN BRIEF

A. Cdre. H. J. Maguire is to be A.O.C. No. 13 Group from November 9, with the acting rank of air vice-marshal.

* * *

No. 2 F.T.S. at Syerston is to be the first R.A.F. flying training school to give all instruction on jet aircraft. Hunting Jet Provosts were due to start arriving last week and the first pupil pilots are to begin training next month.

* * *

The Sandison Trophy for the most outstanding F.A.A. fighter strike pilot of the year was presented to Lt. P. H. Perks of No. 807 Sqn., one of the members of the R.N. aerobatic team in the Farnborough display, at Lossiemouth last Friday.

* * *

Fighter Command's annual awards for air gunnery, the Ingpen and Dacre Trophies, have been won this year by Nos. 46 and 66 Sqns. respectively. Air Marshal H. D. McGregor, the A.O.C-in-C., presented the Ingpen Trophy to No. 46 Sqn. (equipped with Javelins and commanded by W/C. F. Sowrey) at Waterbeach on September 16; and the Dacre Trophy was to be presented to No. 66 Sqn. (Hunters; S/L. P. Bairsto) at Acklington last Tuesday by its donor, A. Cdre. G. B. Dacre.

AVIATION NEWS

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